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STAFF APPRAISAL REPORT

KOREA

SECOND TECHNOLOGY DEVELOPMENT PROJECT

September 26, 1984

Industry Department
Energy & Industry Staff

CURRENCY EQUIVALENTS 1/

US$1	= Won 799.20
US$1 million	= Won 0.79 billion
Won1	= US$0.00125
Won1 million	= US$1,251
Won1 billion	= US$1,251,125

FISCAL YEAR

Government and KTDC - January 1 - December 31

PRINCIPAL ABBREVIATIONS AND ACRONYMS USED

FKI	Federation of Korean Industries
KAIST	Korea Advanced Institute of Science and Technology
KDB	Korea Development Bank
KDIC	Korea Development Investment Corporation
KFSB	Korea Federation of Small Business
KIET	Korea Institute of Electronics Technology
KTAC	Korea Technology Advancement Corporation
KTDC	Korea Technology Development Coporation
MOF	Ministry of Finance
MOST	Ministry of Science and Technology
R&D	Research and Development
SMI	Small and Medium Industry
SMIPC	Small and Medium Industry Promotion Corporation
TDR	Technology Development Reserve

1/ As of July 2, 1984

KOREA

SECOND TECHNOLOGY DEVELOPMENT PROJECT

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This report is based on the findings of an appraisal mission to Korea in February 1984. Mission members included Messrs. Y. Suzuki (Mission Leader), O. Issa and E. Njomo (World Bank), and Y. Lee (Consultant).

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MAP: IBRD Map of Korea (IBRD 12351R2)

LOAN AND PROJECT SUMMARY

Borrower	:	Korea Technology Development Corporation (KTDC)
Guarantor	:	Republic of Korea
Amount	:	$50 million, including the capitalized front-end fee
Terms	:	Payable in 11 years including five years of grace at the World Bank standard variable interest rate
Relending Terms	:	KTDC would pass on the proceeds of the Bank loan to the final beneficiaries in the following three ways: (a) conventional loans to subborrowers with a maximum term of 10 years including three years grace with an effective spread of at least 2.5% above the respective cost of funds to KTDC; (b) conditional loans that would provide KTDC with a partial claim on sales revenues in the case of successful projects but where KTDC would recover only a portion (commonly 30%) of the loan if no sales revenues are generated; (c) equity participation in companies set up to commercialize R&D results. The foreign exchange risk would be borne by the subborrowers of loans and by KTDC on equity investments.
Project Description	:	The overall objective of the project is to foster the technological development of Korean industry. Specifically, the project would consist of two major components:

(a) A line of credit to cover the estimated foreign exchange requirements of subprojects to be financed by KTDC during 1984-86; and

(b) Institutional development of KTDC, comprising: (i) consulting services to support the operations of KTDC and training of KTDC staff, both to further deepen KTDC's capacity to identify, appraise, and supervise R&D projects and to enable KTDC to carry out surveys of the technological needs of Korean industries; and (ii) purchase of training materials for KTDC staff.

Risks : Project risks are related mainly to the trade-offs between intermediate- and long-term goals, such as the development of SMIs and expansion of risk-sharing operations, and more immediate needs, such as the establishment of a profitable and viable institution. Provisions have been included in the project to mitigate this risk substantially.

Financing Plan 1984-86 :

	W Billion	US$ Million	%
Equity - Private	13.3	16.6	9
- Government	9.0	11.3	6
Subtotal	22.3	27.9	15
Long-Term Loans			
Government	37.8	47.3	27
KTDC Bonds	28.5	35.6	20
IBRD (1st & 2nd)	53.5	66.9	38
Subtotal	119.8	149.8	85
Total Financing Required	142.1	177.7	100

Estimated Disbursements :

Bank FY	1985	1986	1987	1988	1989
	US$ Million				
Annual	7.5	14.0	17.5	9.0	2.0
Cumulative	7.5	21.5	39.0	48.0	50.0

I. INTRODUCTION

1.01 The Government of the Republic of Korea has requested Bank assistance to finance a project that would facilitate the development of industrial technology in Korea. The project executing agency, the Korea Technology Development Corporation (KTDC), was established in May 1981 to promote and finance private industry's research and development (R&D) activities. The Bank extended a loan of US$50 million to KTDC on March 25, 1982 (Loan 2112-KO). The loan was fully committed at the end of August 1984, six months ahead of the original schedule.

1.02 The proposed Second Technology Development Project would aim at continuing support for the Government's effort to accelerate the development of industrial technology through continued Bank involvement in the second phase of KTDC's institution building. The project would (a) assist KTDC's institutional development through technical assistance, staff development and training; (b) assist KTDC's catalytic role in technology innovation; (c) help establish a resource base for KTDC that would be sustainable over the long-term; (d) expand KTDC's operations involving risk-sharing financial instruments such as conditional loans and equity investments; and (e) expand KTDC's support to small- and medium-scale industries (SMIs).

1.03 Korea's economic development within the last two decades has been characterized by high annual growth rates of GNP, a rapid shift from an agriculture-based to a semi-industrial economy, and a dramatic increase in the external sector. The share of the manufacturing sector in GNP has more than doubled over the period with corresponding decline of the share of agriculture. Exports grew at an annual rate of 33% in real terms; imports grew at a rate of about 20%. The impressive development of the industrial and manufacturing sectors was based largely on expansion of light industrial goods, in which Korea had comparative advantage because of its low cost and efficient labor. Since the early 1970s, however, the country has become increasingly aware of the need to make its industrial structure more technology intensive.

1.04 Korea has made significant progress in expanding R&D investment. Total R&D spending as a proportion of GNP increased sharply--from about 0.4% in 1970 to 0.6% in 1978, to 0.95% in 1982. The sharp increase during the 1970s and early 1980s was the result of the establishment of 15 additional public research institutes between 1977-1979 designed to strengthen the nation's R&D infrastructure. Growing awareness on the part of industry of the need to maintain their competitiveness and a number of fiscal measures further encouraged R&D spending by private firms. With a continued emphasis on R&D investment by the private sector, whose R&D investments amounted to US$380 million in 1982, the Government's plans call for an increase in the ratio of R&D spending to GNP to 2% by 1986 and to 2.5% by the year 2000 (compared with 2.3% in the United States and 2.0% in Japan in 1980). The number of R&D personnel is also projected to increase from 16,000 in 1979 to 110,000 in 1991.

1.05 During the implemention of the First Technology Development Project, the dialogue between the Bank and the Government on R&D policies focused on the need to establish closer links between industry and the public sector research institutes, and policies intended to support and promote the development of private industry's R&D capability. The Bank's experience with these periodic exchanges of views has in general been satisfactory. As part of the Second Structural Adjustment Loan approved in November 1983, the Bank assisted the Government in revising the Foreign Capital Inducement Act. To further strengthen the Bank's policy dialogue with Korea on technology issues, plans are under way for sector work to review the efficacy of specific policy incentives, programs, and institutions related to the development of industrial technology in Korea.

1.06 The Bank Group's direct involvement in assisting the Government's effort to foster the technological development of Korean industry was initiated in 1979 with Bank financing for the Electronics Technology Project (Loan 1676-KO). The project, which is nearing completion, has sought to develop the capacity of the Korea Institute of Electronics Technology (KIET) to support the local electronics industry by providing specialized services, manpower training, acquisition of foreign technology and by undertaking, jointly with industry, R&D work. KIET has successfully demonstrated to private industry the feasibility of establishing a Korean-run, advanced semiconductor processing facility. The Bank has also assisted the Small and Medium Industry Promotion Corporation (SMIPC) (Loan 2215-KO), which complements the activities of KTDC by providing support to SMIs for expansion of facilities. In May 1983, IFC invested W 750 million in the newly created Korea Development Investment Company (KDIC), a venture capital company whose primary objectives include the provision of equity finance for commercialization of new technology. The Bank has also extended two education sector loans (Loans 1800-KO and 2427-KO in 1980 and 1984, respectively) to improve the quality of higher education in science and engineering, and to increase the supply of qualified Korean engineers, technicians, and managers. The second loan would lay the basis for a strong network of academic institutions for graduate training and research in science and engineering.

II. INDUSTRIAL TECHNOLOGY RESEARCH AND DEVELOPMENT IN KOREA

A. R&D Process and R&D Financing for Industrial Technology Development

2.01 Since this is only the third project of this type to be presented to the Board in the last seven years (the other two being loans 1425-SP to the Spanish Government in May 1977 and 2112-KO, the first loan to KTDC in March 1982), the following paragraphs briefly describe a general conceptual framework for the R&D process and R&D financing. The so-called product life cycle (or technology innovation cycle) can be generally divided into four phases: start-up, precommercial, expansion and maturity. Thestart-up phase comprises idea generation, feasibility studies and technical R&D. The pre-commercial phase involves the development of prototypes and pilot plants, preliminary production and test marketing. During the

expansion and maturity phases, the production and sales grow and eventually taper off.

2.02 Each phase is associated with distinct risks and uncertainties. Typically, during the start-up phase, the major uncertainty is of technical nature. Is the technology to be developed or improved within the reach of technological capabilities available to the individual and/or the corporation involved? What are the associated costs and the time required? Would the technology which would emerge eventually have wide commercial applications? Financial commitments initially tend to be relatively small and increase gradually, but in some cases they can snowball as the R&D work experiences repeated failures. During the precommercial phase, the nature of the technical risks gradually changes. How to expand the pilot-scale operation into a commercial-scale one? How to minimize development and production costs? Commercial and market risks become increasingly important during this phase. Is the market ready for this type of product? What are the segments of the market to be targeted, and how to communicate with them? Time also becomes a critical factor. Are we the first in the market? What are competitors doing? During the expansion and maturity phases, major uncertainties are focused on commercial and market aspects. How to expand production quickly and reduce production costs? How to penetrate into new market segments? How to prolong the product's life span and rejuvenate the product with relatively minor modifications?

2.03 Each phase also has typical financing patterns. In the start-up phase, a newly launched entrepreneur usually draws on private funding sources, i.e., his/her own savings and borrowings from family and friends; the ongoing firm draws on internally generated funds, Government R&D grants and long-term loans, etc. In the precommercial phase, funds are drawn substantially from the same sources as in the first phase, with greater emphasis on venture capital and less on concessionary Government financing or subsidies. The expansion and maturity phases are normally financed by self-generated funds, investment and commercial banks, supplemented, if necessary, by Government incentives such as preferential interest rates and tax incentives. Traditional financial institutions such as commercial and development banks are primarily concerned with financing the expansion and maturity phases (or collectively postmarket phases), when the technology is tested and proven, the market is reasonably assured and the outcome of the project is predictable and relatively certain. Typically, the first two phases contain major uncertainties beyond the level acceptable for such financial institutions. Several factors contribute to the reluctance by traditional bankers to finance such projects: (a) lack of technical and market expertise to evaluate the risk properly; (b) lack of organizational and managerial tradition to include risky loans in their portfolio; (c) lack of viable collateral because of software intensity and low collateral value due to specialized needs for R&D equipment. As a result, institutional gaps exist in many developing economies, which do not allow the capital market to adequately meet specific financing requirements for the start-up and precommercial phases (or collectively premarket phases) of the technology innovation cycle.

2.04 Several developing countries and almost all the industrialized nations have recognized the key role of public support for technology promotion schemes in some form or other. There are sound economic reasons for doing so even in a market economy. First, the socioeconomic return of technology development activities are generally higher than the private return because such activities generate substantial externalities in the form of knowledge as well as other material benefits which cannot be all appropriated by the developer. Second, the outcome of these activities is uncertain which makes R&D investment quite risky. Thus, even though the expected benefits of individual projects may be larger than the costs, individual entrepreneurs who are typically risk averse may not invest in them but society as a whole which has access to greater portfolio diversification opportunities can afford to be close to risk neutral. Consequently, from the point of view of the economy as a whole it is beneficial to compensate for the tendency of individual entrepreneurs to underinvest in such activity. Third, many R&D activities especially those of relevance to modern industry require lumpy investments which also call for government intervention to correct for market failure. Lastly, as mentioned above, even when the entrepreneurs are willing to invest in technology development activities, typically, gaps exist in the capital market which preclude financing such as risky and software-intensive ventures.

B. The Macroeconomic Background

2.05 Within the last two decades, Korea has transformed itself from one of the poorest developing countries, heavily dependent on agriculture with a weak balance of payments financed almost entirely through foreign grants, to a semi-industrial, middle-income country with a fairly strong external payment position. During 1960-1981 GNP grew by over 8% p.a. and per capita income more than tripled in real terms. The share of the manufacturing sector in GNP rose from 14% to 30% while the share of agriculture fell from 36% to 18%. Exports grew at an annual rate of 33% in real terms while imports grew at a rate of about 20%. This rapid growth in output was accompanied by a matching growth in employment and real labor income.

2.06 Such impressive development in the industrial and manufacturing sectors was initially based on light industrial goods such as textiles, apparels, wood products and household goods in which Korea had comparative advantage due to its low cost and efficient labor. However, the country has become increasingly aware of the need to transform its industrial structure towards a technology-intensive one. A number of considerations make this imperative: (a) poor resource endowment; (b) a quickly disappearing comparative advantage in labor-intensive industries; (c) a desire for continuing gains in labor productivity through technological advancement; and (d) a desire to secure the long-term competitive advantage of technological and innovative capacity.

2.07 In the mid 1970s, first steps were taken to deepen the industrial base and diversify the mix of manufactured exports through the creation of

capital intensive metal and chemical industries. With increasing industrial maturity, the process of diversification has continued and Korean firms have begun to move into fields of higher technological intensity such as electronics, machinery and fine chemicals, where the domestic value added is much greater and export demand brisk. Having committed itself to developing these subsectors, Korea must now adopt measures that will bring it technologically abreast of some of its competitors and establish its position in the world market. The Government and private sector firms are keenly aware of this and have already taken important steps as discussed below (paras 2.08-2.26).

C. Korea's R&D Spending Pattern

2.08 Overall R&D Spending: Total R&D spending in Korea has increased significantly during the recent years:

Table 2.1: Korea - R&D Spending

	Total R&D Spending (Won million current terms)	R&D Spending/GNP (%)
1970	10,547	0.39
1975	42,663	0.44
1980	211,726	0.62
1982	457,688	0.95

Source: Ministry of Science and Technology

As a percent of GNP, total R&D spending almost reached 1% in 1982. Korea's total R&D spending as a percent of GNP is among the highest in the developing countries and is now comparable to some developed countries. However, it is still considerably below those in highly industrialized countries such as the United States (2.3%), Federal Republic of Germany (2.6%), and Japan (2.0%).[1]/ The Fifth Five-Year Plan targets the ratio increasing to 2% by 1986 and to 2.5% by year 2000 (Annex 13).

2.09 R&D Spending by Sector: R&D activities in Korea are conducted by three sectors: (a) public sector institutes, (b) universities, and (c) industry. Public sector institutes consist of two distinct groups -- (a) government research institutes, which are financed and managed by central and regional governments to promote the nation's policy, public

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1/ 1980 figures. Given the nebulous nature of technology development and the insufficient quality of data, R&D statistics should be viewed only as indicators of general trends and broad guides for international comparison.

interest and welfare, and engage in testing and limited research activities in various areas (agriculture, forestry, fishery, climatology, astronomy, public health); and (b) 12 nonprofit research institutes, such as the Korea Advanced Institute of Science and Technology (KAIST) and the Korean Energy Research Institute, which are mostly supported by the Government's budget and have the specific directive to promote R&D in their respective areas of specialization. Nonprofit research institutes and industry are the two dominant sectors accounting for 29% and 45% of total R&D spending in 1982 (Annex 1, Table I). In comparison with more advanced countries, the share of industry in R&D is, although increasing rapidly, still low. This gap, however, is partially filled in Korea by the comparatively greater spending by nonprofit research institutes (Annex 1, Table II).

2.10 Spending by Nature of R&D Activity: In 1981, 47% of direct R&D expenses went to development (downstream work); while basic and applied research (upstream work) accounted for 53% combined. Despite continued efforts to promote R&D activities in the areas most responsive to industry's needs, Korea's overall R&D investment, compared with more advanced countries, is still oriented more toward basic and applied research (Annex 1, Table III).

2.11 Research Expense Per Researcher: The average research expense per researcher increased from W 5.2 million to W 16.1 million during 1976-1982 (Annex 1, Table IV). Although industry is catching up quickly, nonprofit research institutes command the highest level of R&D expense per researcher, almost twice as much as industry. Korea's overall R&D spending per researcher of US$21,500 equivalent (1982) compares unfavorably with US$142,000 in the Federal Republic of Germany (1979), US$137,000 in France (1979), US$98,000 in the United States (1980), and US$71,000 in Japan (1980).

D. R&D Activities by Industry

2.12 Korea's initial industrialization was based on mature and easily transferable technologies proven elsewhere. With the growing sophistication of industry and rising labor costs, Korean entrepreneurs have felt an increasing need to develop their technological capabilities. The immediate natural reaction was to import the required technologies. However, with the increasing technological capability of the Korean industry, Korean companies have recently begun to experience some difficulties in obtaining adequate technology from firms in more advanced countries. From this experience, Korean entrepreneurs appear to have determined that, while imported technology has a critical and continuing role to play in industrial development, Korea must also develop its own technological capabilities to ensure the long-term competitiveness of the domestic industry. This growing awareness, supported by Government policies and incentive schemes (paras 2.25 and 2.26), has resulted in the dramatic increase in R&D activities by industry, from W 15 billion in 1976 to W 205

billion in 1982. The number of R&D centers affiliated with Korean industry increased from 43 in 1979 to 112 in 1983. For SMIs and for R&D in emerging fields such as biotechnology, the Government encourages firms to join forces and establish R&D cooperatives. Currently, there are 14 of these R&D cooperatives established by 83 member firms.

2.13 During the short period of 1979-1982, the proportion of expenditures on R&D to total sales revenues for all manufacturing industry increased from 0.33% to 0.65% (Annex 1, Table V). Another indicator of the R&D intensity is the proportion of researchers in the overall employment (Annex 1, Table VI). As a proportion of total employees, the number of R&D personnel in Korea is about one half of those in the United States or Japan.

E. Nonprofit Research Institutes

2.14 Out of 12 nonprofit research institutes, 9 fall under the administrative responsibilities of the Ministry of Science and Technology (MOST); the Ministries of Trade and Industry, of Construction, and of Health and Society each administer one. Most of these nonprofit research institutes and their predecessors were established during 1976-1978 with the primary objective of strengthening the technological infrastructure of Korean industry by performing industry-oriented research and support activities. These objectives were justifiable, particularly during the initial years when private industry was unable to establish its own R&D centers. The Government-supported nonprofit research institutes were considered, at that time, to be the only feasible means to cater for industry's technological needs. Collectively, these institutes spent W 131 billion in 1982 or about 30% of the nation's total R&D expenditures.

2.15 However, the ability and capacity of these institutions to effectively meet industry's rapidly growing and increasingly complex technical needs has been limited. Financial and human resources were too thinly spread over too many research institutes, in some cases with overlaps in R&D areas. More importantly, however, the institutes initially recruited a large number of their staff from academic fields, the only readily available sources of recruitment. Unfortunately, these researchers were particularly weak in manufacturing know-how and in their ability to develop prototypes, and have been typically unable to assist industry in solving its practical problems. Despite the major efforts made in 1980/81 to consolidate nonprofit research institutes and to streamline administrative responsibilities, only 8% of industry's total R&D spending was contracted out to these institutions and such revenues only accounted for 17% of the overall R&D budget of these institutions. Despite this apparently low level of interaction, the nonprofit institutes continue to concentrate heavily on the development stage of R&D activities (Annex 1, Table III) against the researchers' inherent interest and their comparative advantages vis-a-vis industry.

2.16 The Government considers a closer linkage between industry and non-profit research institutes important. To strengthen this relationship, in 1982 the Government initiated "National Projects" to develop broad technological infrastructure in priority areas (such as semiconductors, computers, fine chemicals, mechanical industry, material science, plant system engineering). The national project scheme is divided into two parts: Government-initiated projects, and industry-initiated projects, with the former conducted by non-profit institutes alone, and the latter conducted together with industry on a joint research basis. In 1983, 56 government-initiated projects amounting to W 16 billion (US$20 million equivalent) and 124 industry-initiated projects amounting to W 18 billion (US$23 million equivalent) were implemented; the private sector met about two-thirds of the cost of the latter project. Selection of these projects was made primarily by MOST. In an effort to improve the selection and implementation of the National Project Scheme, the Government has, starting in 1984, decided to utilize KTDC's appraisal function by channeling about W 3 billion through KTDC. The performance of national projects will have to be reviewed within the overall context of the function and management of nonprofit research institutes and their linkage to industry.

2.17 There is a need to redefine the respective roles of public and private research institutes in the future. The need for support to private industry for the downstream stage of R&D has probably decreased as companies have established their own research capabilities. However, it is also possible that, as industry's technological capacity increases and its focus on R&D shifts quickly to more advanced technologies, it will require more support, particularly in basic and advanced applied research, which nonprofit research institutes may be better equipped to provide.

2.18 There is also a need to address the issue of management of the nonprofit research institutes with a view to making them more responsive to industry's needs in selecting and implementing research projects, and more accountable for their efficiency and outputs. For example, in allocating resources to nonprofit research institutes, the Government, based primarily on historical performance, first estimates the institution's overall financial requirements and expected earnings from outside contracts. The Government then allocates its budget on the basis of the estimated shortfall. Unfortunately, this system hardly provides incentives to researchers who attract outside contracts from industry. Furthermore, managers of these institutions have only limited means to reward high performers because of the Government's strict control of the institutes' budgets.

F. Manpower Development

2.19 In recent years, Korea has dramatically increased the technological manpower for R&D as shown below:

Korea - Development of Technological Manpower

Year	Public Sector Institutes		Industry		Universities		Total	Per 10,000 Population
	Persons(P)	%	(P)	(%)	(P)	(%)	(P)	Persons
1977	4,039	(32)	3,896	(38)	4,836	(38)	12,771	3.5
1980	4,598	(25)	5,141	(28)	8,695	(47)	18,434	4.8
1982	6,129	(22)	9,959	(35)	12,360	(43)	28,448	7.3

However, the number of research scientists and engineers engaged in R&D still remains low compared with more advanced countries (25-30 researchers per 10,000 population). In addition, the share of these scientists and engineers in industry represents about 35% of total R&D manpower, compared with the level of 55-65% in the more advanced countries.

2.20 The Government projects that the demand for research scientists and engineers will reach 110,000 by the early 1990s. To meet such a demand and with the Bank's active involvement, the Government has accorded priority to expanding and upgrading science and technology education at graduate and undergraduate levels. The Government's major objectives are to: (a) improve the quality of graduate programs; (b) expand the programs and strengthen the management of the Korea Science and Engineering Foundation, the key institution for the promotion and funding of science and technology research; (c) improve collaboration in graduate education and research among graduate schools and research institutes; (d) increase the supply, and improve the qualification, of faculty members in science and engineering; and (e) improve laboratory and other facilities essential for science and engineering education. The Bank has extended an education sector loan (Loan 2427-KO) to help the Government achieve some of these objectives.

G. KTDC and Other Industrial Support Organizations

2.21 Given the limited role that traditional financial institutions can play in R&D financing (para 2.03), a specialized institution, KTDC, was created in May 1981 primarily to promote and finance R&D projects. In the short time since it was established, KTDC has emerged as a major financing mechanism for R&D in Korea. Equally important are KTDC's emerging role in identifying technological gaps and promoting related R&D activities, and the pool of expertise it has developed in this specialized field. KTDC's functions, issues and programs designed to increase its effectiveness are discussed in Chapter III of this report.

2.22 KTDC complements activities of existing Korean financial and other industrial support organizations. The Korea Development Bank (KDB) initiated Technology Development Loans in 1976 to finance R&D activities, commercialization of R&D results and purchases of R&D equipment. To date,

KDB's Technology Development Loans have been primarily concerned with commercialization of R&D results whereas KTDC's operations have been focused more on the upstream R&D activities. KDB is catering mostly to its traditional clientele of large firms, whereas about half of KTDC's clientele are SMIs. In April 1984, KDB announced that it would establish a venture capital outfit within its organization. Although the detailed modus operandi is yet to be established, this development could further accelerate the acceptance of the risk-sharing concept among Korean entrepreneurs (para 4.06).

2.23 Other institutions with which KTDC has close complementary functions include the Korea Technology Advancement Corporation (KTAC) and Korea Development Investment Corporation (KDIC). KTAC specializes in commercialization of R&D results from the Korea Advanced Institute of Science and Technology (KAIST) through sales of know-how and equity investments. Thus, its operational scope is limited. KDIC was established in December 1982 as the first venture capital company with 100% private sector ownership in Korea (para 2.27). The Small and Medium Industry Promotion Corporation (SMIPC) provides extension services, technical assistance and training to SMIs (para 2.27). KTDC has close cooperative arrangements with SMIPC, KTAC, KDIC and other organizations under which they jointly cater for the broader technical and financial needs of their respective clients.

H. Policy Towards Industrial Technology Development

2.24 To date, Korea has initiated an impressive array of policy and administrative measures to facilitate the development of industrial technology and address some of the issues as discussed previously. Strategies behind these measures have been to: (a) encourage R&D investments by industry as much as possible; (b) liberalize foreign technology imports; (c) increase the linkage between industry and nonprofit research institutes; and (d) create suitable financing mechanisms for R&D activities, particularly for SMIs. Furthermore, to complement these measures, the Government has increased education sector investments to improve the quality as well as the quantity of technical manpower.

2.25 Incentive Schemes for R&D Investments by Private Industry: To encourage R&D activities by industry, the Government has initiated various incentives, including the Technology Development Reserve (TDR), tax credits for R&D expenditures, accelerated depreciation for investments to commercialize R&D results, and reduced excise tax for technology-intensive products. Under the TDR scheme, a company can set aside up to 20% of profit before tax or 1% of revenues in any year for the following four years, subject to MOST approval of its R&D program. In the case of technology-intensive industries, the allowable percentage is 30% of net profit or 1.5% of revenues. In effect, the TDR scheme allows companies to write off R&D expenditures up to four years before actual expenditures are incurred. If TDR funds so accumulated are not used within four years, however, the company must pay back taxes on the unused balance as well as a penalty. During 1974-1983, the TDR balance increased from W 2.9 billion to W 56.5 billion while the number of participating companies increased from

60 to 160. Specifics of other selected tax incentives are briefly described in Annex 2. There is no doubt that these measures have collectively been a major contributory factor to the rapid increase in industry's R&D activities. TDR accounts have also been the main sources of the private sector's equity contribution to KTDC.

2.26 Liberalization of Foreign Technology Import: Korea's technological acquisitions during the 1960s and 1970s were predominantly achieved through imports of turnkey plants and machinery rather than more direct proprietary transfers through direct foreign investments and licencing agreements. In fact, the Government's attitude towards direct foreign technology imports was circumspect.[2/] Towards the end of 1970s, however, Korea changed its orientation. During the brief period of 1978-1980, the Government launched a four-stage technology liberalization program which resulted in a major simplification of the approval process. Furthermore, as a result of amendments made to the Foreign Capital Inducement Act in 1983, industry can now import virtually any technology (except for technology related to defense and nuclear safety) without prior government clearance. In a related move, the present list of industries open to direct foreign investment is currently being replaced with a negative list, specifying only those industries in which direct foreign investments are prohibited or restricted. The number of industries in which foreign investment is permitted will be substantially increased under the new system. Administrative procedures for direct foreign investment are in the process of being simplified. All applications by prospective foreign investors satisfying specific criteria (including the foreign investor's share of equity in the project and the total amount of foreign equity) will be approved by the Ministry of Finance immediately. The major policy issue in the future is the balance between the development of indigenous technology and imports. The fact that several developed countries are becoming increasingly unwilling to transfer state-of-the-art technology as Korea advances its technological capability requires that Korea give this issue increasing attention in the coming years.

I. The Role of the Bank

2.27 As discussed above, Korean industrial technology development policies have, over the last decade, been characterized by initiative and foresight. The Bank has assisted the Government both through an active dialogue on technology policy and institutional issues and through specific projects designed to support various parts of the investment programs that complement policy. The Bank Group's first direct involvement in technological development was initiated in 1979 with Bank financing for the Electronics Technology Project (Loan 1676-KO). The project, which is nearing completion, seeks to develop the capacity of KIET to support the local electronics industry through provision of specialized services, manpower training, acquisition of foreign technology and undertaking,

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2/ Reflections on Korea's Requisition of Technological Capacity. IBRD Draft Report DRD 77, April 1984.

jointly with industry, production and R&D work. KIET has successfully demonstrated to the private industry the feasibility of establishing a Korean-run advanced semiconductor processing facility without expensive license and has developed 8-bit microprocessors and other advanced products. The first Bank loan to KTDC (Loan 2112-KO) in 1982 was aimed at helping to bridge a serious gap in the Korean financial system by providing financial assistance for typically risky technology intensive industrial R&D projects (see Chapter IV for assessment of KTDC's development under that project). The Bank has also assisted the SMIPC (Loan 2215-KO) which provides shop-floor advice and guidance to increase the productivity of small and medium enterprises. Its activities are concentrated on the downstream or market phase of the technology innovation life cycle and on relatively mature technologies. Thus, SMIPC complements the activities of KTDC which operates mainly in the premarket phase of the technology innovation cycle. In May 1983, IFC invested W 750 million in the newly created Korea Development Investment Company (KDIC) a venture capital company whose primary objective is to provide equity finance for commercialization of new technology. Finally, through sector loans made in 1980 (Loan 1800-KO) and earlier this year (Loan 2354-KO) the Bank is assisting in the upgrading and expansion of higher education for science and engineering. The Bank's dialogue in these areas has generally been excellent and the objectives of the first education sector loan, now nearing completion, have been substantially realized.

2.28 As part of the First Technology Development Project, provision was made for the Bank and the Government to engage in periodic discussions of the Government's R&D policies especially with regard to establishing closer links between industry and the public research institutes and policies aimed at supporting and promoting the development of industry's R&D capability. Similarly, as part of the Second Structural Adjustment Loan approved in November 1983, the Bank assisted the Government in revising the Foreign Capital Inducement Act. The Bank's experience with these periodic exchanges of views has been generally satisfactory. Given the dynamic nature of R&D activities, it is important that the policy and institutional environment be the subject of continuing review. During the proposed project, the Government and the Bank will continue to exchange views on existing and emerging issues on technology policy. Some areas requiring review include the role of small and medium industries, measures to facilitate the role of KTDC and other institutions in promoting venture capital activities and measures for patent and copyright protection. Preliminary studies have already been initiated in some of these areas. The Bank's role would, through sector work and the supervision of the proposed project, be primarily one of advising the responsible agencies on the design and implementation of Korea's technology-related policies.

III. THE KOREA TECHNOLOGY DEVELOPMENT CORPORATION (KTDC)

A. Institutional Goals

3.01 KTDC was established on May 1, 1981, with strong support from the Government and private industry. The Bank played an active role in KTDC's conception, and in designing its ownership, organizational structure, and operational policies and procedures. KTDC's principal goals are to promote the development of industrial technology, and to facilitate desirable changes in industrial structure, so as to strengthen the international competitiveness of Korean industry.

3.02 To achieve these goals, KTDC performs several important functions as described below:

(a) Financing R&D Projects: One of the important institutional gaps that existed in the Korean capital market prior to KTDC's establishment was R&D financing for industrial technology (paras 2.03 and 2.21). KTDC actively identifies and appraises R&D projects initiated by industry during the premarketing phases of the product innovation cycle (para 2.01). Types of projectsKTDC finances are described in Annex 3;

(b) Venture Capital Operations: The Government and private industry in Korea intend to use venture capital operations to develop industrial technology quickly. KTDC is playing the pioneering role in this area. The crux of this operation is the concept of risk (and, consequently, reward) sharing by KTDC and respective private entrepreneurs, inventors, and technology innovators;

(c) Promotion of Industrial Technology Development among SMIs: Considering the important role that SMIs can play in industrial technology development, and in view of their demonstrated success in more advanced countries, the Government and the private sector are anxious to promote technological development through SMIs. KTDC, along with other industrial support organizations (paras 2.22-2.23), plays a key role in this effort;

(d) Brokerage Services: KTDC's unique position and the extensive contacts that it has developed with private industry, research institutes, and financial institutions permit it to increasingly provide brokerage services in matchmaking among researchers, inventors, and entrepreneurs both in Korea and overseas. This function is important in facilitating R&D activities and in commercializing of their results; and

(e) Information Services: With its intimate knowledge of the status of technological development and the needs of industry, KTDC assists industry and the Government in identifying technological trends, market prospects, and emerging areas of focus for R&D efforts and commercialization prospects. In addition to close association with similar organizations in other countries, KTDC is affiliated with some US venture capital companies that provide KTDC with additional avenues for such information.

In addition, based on its experience and expertise, which are unique in Korea, KTDC is playing an increasingly important function to consult and advise various government agencies in identifying major policy constraints and suggesting appropriate measures.

B. Legal Framework and Ownership

3.03 The Korean Technology Development Corporation Act and the related Enforcement Decree which established KTDC enable the institution: to operate in an autonomous manner with the efficiency of a private company; to have a strong and independent management; and to attract and retain staff of high caliber and entrepreneurship. As of end 1983, KTDC was roughly 80% owned by the private sector and 20% by the Government (para 4.07). The private sector ownership of KTDC is broadly based, including 14 industrial groups, 83 individual firms, and 5 banking institutions (Annex 13). To avoid undue concentration of influence, the KTDC Act limits ownership and/or voting rights by any private shareholder to no more than 7%. The proportion of the SMIs' shareholding is only 0.7% of the total paid-in capital. Given the financial situation of SMIs, prospects of substantially increasing the SMIs' share is limited at present. SMIs' interest, at the KTDC's Board level, is safeguarded principally through representation by the Vice Minister of MOST (on behalf of the Government) and the President of the Korea Federation of Small Business (KFSB). The KTDC Act specifically mandates its management to give priority to SMIs by allocating not less than a certain prescribed portion of KTDC's total financial resources to such enterprises (para 4.03). Also, in appraising financing applications, KTDC makes no reference to the applicants' status in KTDC shareholding.

C. Operating Policies and Procedures

3.04 KTDC's Statement of Investment and Operational Policies (Annex 13) provides guidelines for KTDC operations, including the scope of loan and investment activities, criteria for investment decisions, diversification of assets, promotion of SMIs, relations with clients, and generation of profits. With respect to asset diversification, KTDC has confirmed that it will continue to apply its existing policy, which limits its total financing commitment outstanding at any time to any single enterprise to not more than 7% of its long-term portfolio. Combined with

other operational policies (such as limiting KTDC's equity investments in any single enterprise to not more than 10% of its paid-in capital and free reserves), there are adequate safeguards to protect KTDC from an undue concentration of its assets. In addition, details of the terms and conditions of KTDC's loans and equity investments and procedures are given in the Statement of Rules on the Lending and Equity Participation (Annex 13).

3.05 To promote the undertaking of R&D projects by industry, which inherently involve substantial risks and a long gestation time, KTDC shares both the risk of failure and the benefits of success. To this end, KTDC offers the following types of financial support:

(a) Conventional Loans: with or without collateral requirements;

(b) Conditional Loans: that allow profit and risk sharing with project sponsors. Such loans are normally repaid through royalty payments from sales revenues if the project is successful, including a reasonable return on the loans; if the project does not result in sales revenues, KTDC recovers only a portion of the principal from the sponsor; and

(c) Equity Investments: in companies set up to commercialize R&D results.

3.06 KTDC management considers that expanding operations involving conditional loans, which KTDC has introduced in Korea, and equity investments are particularly important because R&D investments by private industry particularly among SMIs would multiply when these risk-sharing financial instruments become widely accepted. KTDC's ability to provide loans without collateral is unique in Korea; they are particularly appropriate for software-intensive projects carried out by SMIs who are typically unable to provide security. Since its financing is oriented toward risk sharing, KTDC plans to give increasing emphasis to such operations, rather than to hardware loans with collateral security, because financing for the latter is more easily available from other financial institutions.

3.07 Typically, KTDC receives preliminary inquiries from local entrepreneurs, researchers, and inventors with project ideas. Often, a project idea at that stage is neither well conceived nor sufficiently developed to constitute a bankable project. Through interviews with potential applicants, KTDC staff determine whether to encourage formal applications. Staff also provide advice and suggestions based on their own expertise. Once a formal application is received, the Director of the Appraisal Department decides whether to proceed with a formal appraisal or not. The formal appraisal report is reviewed by the President, who decides whether to recommend the project for further considerations by the Board or

Executive Directors. Historically, 75% of the initial inquiries reach formal appraisal, and 50% receive KTDC's financial support.

D. Organization, Management and Staff

3.08 The responsibility for the policy and general direction of KTDC's business rests with the Board of Directors, which currently comprises of the Chairman of the Board, the President, Executive Vice-President, Executive Director, and eight outside Directors, including the Vice Minister of MOST. The President reports directly to the Board and is responsible for KTDC's overall operations.

3.09 The Board, which has the ultimate authority over all investment decisions, has delegated authority to approve individual loans and investments to (a) the President (up to the ceiling of W 300 million or about US$375,000 equivalent) and (b) the Executive Directors' committee consisting of all directors who are full-time managers of KTDC (up to the ceiling of W 500 million or about US$625,000 equivalent). Such delegation of authority has helped to strengthen KTDC's management and helped to enable the institution to respond quickly to private industry's changing R&D needs.

3.10 KTDC has four departments: Appraisal Departments I and II, which are divided by industrial subsectors and are responsible for project identification and appraisal; the Credit Department, responsible for project supervision and administration of loans and investments; and the Planning and Administration Department, responsible for planning, budgeting, economic and market surveys, personnel, and other support services. KTDC's organizational chart is shown in Annex 4.

3.11 Of particular importance is the Venture Capital Management Division recently created in Appraisal Department II. It specializes in equity investments and conditional loans (para 3.05). These activities were previously handled by the respective Appraisal Departments during project identification and appraisal stages, and by the Credit Department during the project supervision stage. Under the new system, the Venture Capital Management Division is solely responsible for all phases of the project cycle. The rationale for this reorganization are: (a) to develop, within KTDC, and as quickly as possible, a critical mass of expertise in risk-sharing financial instruments; (b) to strengthen communication channels to potential clients with keen interest in these instruments; (c) to establish clear terms of reference and accountability for the manager and staff of the team so that the development of venture capital operations (work pioneering in nature, and relatively time consuming) would receive desirable priority in KTDC and (d) to provide adequate supervision and loan and investment administration of these types of activities, which require qualitatively different, and more intensive attention.

3.12 Currently, KTDC has about 40 professional staff with various backgrounds and about 10 years of work experience on average, including R&D

scientists and engineers, project engineers, development and merchant bankers, and lawyers. The varied expertise and interdisciplinary cross-fertilization that have evolved have become the major asset of KTDC. KTDC plans to recruit some additional ten professional staff during 1984-1986. Attrition among the staff has been very low.

E. Staff Development and Training

3.13 KTDC is staffed by highly motivated, capable individuals with excellent academic backgrounds and work experience. Given the unique and evolving nature of its functions and relatively short existence, however, KTDC management and staff must constantly strive to upgrade the corporation's organizational effectiveness and individual staff expertise. It is widely recognized that there is a significant shortage of expertise necessary for venture capital business. This constraint, which also reflects the situation in many developed countries, is mostly due to the relative newness of the profession, which requires skills qualitatively different from those required in traditional financial and industrial management. In addition, the organizational objectives of KTDC are much broader than those of ordinary venture capitalists thus making it necessary for KTDC management to emphasize systematic staff development and training. As part of this effort, KTDC has established a program of systematic staff reassignment every three years on the average to develop an overall corporate perspective and functional flexibility on the part of individual employees.

3.14 The first project included US$650,000 equivalent to be used for technical assistance, training, and educational materials. However, given its relatively tight financial position during its start-up period, KTDC opted for less costly sources of training funds and did not utilize the loan proceeds. To date, KTDC staff have received about 80 man-months of external training in addition to numerous in-house training programs. Such training activities concentrated on areas such as technology innovation and trends, R&D financing, venture capital operations and small business management. To accelerate KTDC staff development, UNDP, KTDC and the Bank have recently concluded an agreement on a "KTDC Institutional Development Project," under which KTDC will receive management and staff training and technical assistance totaling US$226,000. These activities will: (a) further develop KTDC's expertise in project and company analysis, particularly for operations involving risk-sharing financial instruments; and (b) expand KTDC's contacts and information pipelines with overseas high-technology and venture capital firms and institutions with similar objectives. The Bank is acting as the executing agency for the project. Experience to be gained from these programs would be used in designing KTDC's further staff development and training programs, for which purpose, US$300,000 equivalent of the proceeds of the proposed loan is set aside (para 5.02). It is expected that KTDC will continue to prefer grants and other subsidized sources of financing for these activities. If these materialize, the proposed loan proceeds earmarked for this purpose would be reallocated to the line of credit.

IV. KTDC UNDER THE FIRST TECHNOLOGY DEVELOPMENT PROJECT

A. Lending and Investment Operations

4.01 Demand for KTDC's R&D Financing: Since the start of its business, there has been a strong demand for KTDC's R&D financing, which surpassed appraisal estimates by a wide margin, as shown below:

Table 4.1: KTDC Financing Applications and Loan Commitments

Year	Actual				Appraisal Estimate
	Financing Application		Financing Commitment		Financing Commitment
	# of Appl.	Won Billion	# of Com.	Won Billion	Won Billion
1981	92	17.4	49	6.1	3.5
1982	88	46.0	80	22.1	14.2
1983	198	105.3	141	49.9	20.6
Total	378	168.7	270	78.1	38.3

Note: The processing of a loan application takes 1-6 months depending on the specific situation of the project.

4.02 KTDC's performance to date has been very satisfactory. At the end of the last fiscal year (December 31, 1983), KTDC had approved 270 projects amounting to about W 78 billion or more than double the appraisal estimates. KTDC has supported a broad spectrum of R&D activities, ranging from projects dealing with most advanced medical electronics and telecommunications technology, computer hardware and software, to projects involving more basic technology such as educational toys and food processing. Of the financing commitment to date, about 50% accounts for R&D activities conducted in Korea while about 25% accounts for costs necessary for importation of technology including licensing fees and associated training. KTDC has been involved in the commercialization of R&D results only when no other financing sources were available with appropriate terms. The remainder of KTDC's financial support includes commercialization of R&D results and purchases of research equipment for research centers of private firms. The loan and investments extended to small and medium sized companies (SMI) represented 47% by the number of projects and 28% by amount, which substantially met the original targets. In addition to financial services, KTDC has provided other important services associated with technology development including management assistance to startup SMIs, information services to follow technology trends, identification of the specific technological gaps existing in Korea and promotion of R&D activities in such areas. The detailed breakdown of KTDC's operations by industrial subsector and a brief description of selected projects are given in Annexes 5 and 6 respectively.

4.03 Financial Support for Small and Medium Industry: KTDC's operational policy statement stipulates that the proportion, by value, of its financial support to SMIs be at least 20% in 1981 and 30% in 1982 and thereafter. KTDC has substantially met these goals, as shown in Annex 7. The trend is also encouraging. For example, the share of SMIs in KTDC's total financial support increased from 33% in 1981 to 50% in 1983 in terms of the number of projects. In terms of the amount of local currency financing, KTDC's support to SMIs increased from 30% to 35% in the same period. However, SMIs' utilization of KTDC's foreign currency financing, although increasing, has been somewhat low (only 20% of KTDC's total foreign currency financing), because of the nature of R&D activities by SMIs.

4.04 The promotion of R&D activities among SMIs has been a challenging task for KTDC. The major difficulties encountered include: (a) limited in-house technological capabilities among SMIs to identify and develop R&D projects with good prospects for commercialization; (b) limited international contacts to identify sources of technology imports; and (c) severe financial constraints which limit these firms' ability to bear their minimum share of R&D expenses. In spite of these difficulties, KTDC has made commendable efforts to promote R&D activities among these firms through extensive promotional activities and technical and managerial advice. Financing applications to KTDC from SMIs are growing at a much faster pace than those from large companies, as shown below:

Table 4.2: KTDC - Financing Applications by Size of Companies
(Won Billion)

Financing Applicant	1981 [a]	1982	1983	Total	Compounded Growth Rate [b] (%)
Large Companies	14.7	37.7	84.3	136.7	95
Small and Medium[c]	2.6	8.3	21.1	32.0	133
Total	17.3	46.0	105.4	168.7	

a/ 8 months' operation.
b/ Adjusted for a/.
c/ Based on the definition under the Small and Medium Industry Promotion Law: mainly enterprises with assets less than Won 500 million (about US$630,000) or with less than 300 employees, except for those industries where the employment ceiling was revised to 500.

Furthermore, KTDC has consistently approved financing applications from SMIs more aggressively (approving 69% of formal applications) than it has those from large companies (41%). KTDC's business plan stipulates that it set the target proportion for SMI operations at no less than 40% of total financing amounts to be committed during 1984-86. KTDC has agreed that it would review with the Bank by the end of each fiscal year beginning 1984, the operational targets for further promoting its support to SMIs during

the following fiscal year and on the basis of such reviews, introduce such modifications to the targets as shall be mutually acceptable to KTDC and the Bank.

4.05 Financing Activities by Financial Instruments: KTDC supports R&D activities through three kinds of financial instruments: conventional loans (with or without collateral), conditional loans, and equity investments (para 3.05). Under the first project, it was hoped that the conditional loans and equity investments in KTDC's operations would expand from W 0.2 billion in 1981 to W 9.3 billion in 1983. The actual results during 1981-1983 were about 50% of the original targets. In hindsight these indicative targets were optimistic. A number of factors in the Korean environment inherently constrain the expansion of conditional lending and equity investments at the rate envisaged previously: (a) the kind of innovative R&D projects sponsored by SMIs which are the types most suitable for risk-sharing financial instruments are few, and time has to be allowed for these activities to grow; (b) risk sharing is a relatively new concept in Korea, and Korean entrepreneurs tend to be concerned with the erosion of potential profits or the dilution of their ownership; and (c) the legal and organizational framework that would be conducive to the development of venture capital (i.e., flow-through tax,[3]/ a viable over-the-counter market, etc.) has not yet been fully developed.

4.06 KTDC is convinced that these risk-sharing financial instruments will be more widely accepted by Korean entrepreneurs in the future, albeit gradually, and KTDC management is committed to playing a pioneering role in promoting them. As a first step, KTDC established the Venture Capital Management Division (para 3.11). In addition, a business cooperation agreement has been concluded between KTDC, KDIC, and KTAC to promote joint risk sharing for large-scale and/or risky ventures. As a result of these and other efforts, KTDC anticipates that the proportion of conditional loans and equity investments will increase from 4% in 1983 to 12% in 1986. It is further expected that the proportion of these operations would reach about 20% by 1990. These overall targets will be incorporated in KTDC's operational policy statement. It should be noted, however, that due to the relatively recent introduction of these financial instruments to the Korean capital market, these targets are indicative and they would have to be reviewed from time to time taking into consideration experience and actual results of KTDC's operations. Consequently, KTDC has agreed to review with the Bank by the end of each fiscal year beginning 1984, the interim operational targets to be met by KTDC during the following year, and on the basis of such review, introduce modifications to the interim targets as shall be mutually acceptable to KTDC and the Bank. The Government and KTDC have agreed to extend to the proposed loan the principle that was applied under the first loan whereby KTDC would receive additional funds from the Government to cover losses suffered on loans made as conditional loans.

3/ To avoid double and/or triple taxation on income generated by venture capital.

B. Resource Mobilization

4.07 KTDC's resource mobilization during 1981-1983 was as shown below:

Table 4.3: KTDC - Resource Mobilization
(Won Billion)

	1981	1982	1983	Total	Total(%)
Local Resources					
Government Equity	1.0	1.0	1.0	3.0	5.3
Private Sector Equity	6.5	1.3	3.9	11.7	21.0
Total Equity	7.5	2.3	4.9	14.7	26.3
Government Loan	1.0	1.5	1.5	4.0	7.2
KTDC Debenture	-	-	25.5	25.5	45.7
Total Long-term Debt	1.0	1.5	27.0	29.5	52.9
Foreign Currency Resource					
IBRD Loan [a/]	-	4.1	7.5	11.6	20.8
Total Resources	8.5	7.9	39.4	55.8	100.0

[a/] On disbursement basis.

4.08 Originally, the Government had committed itself to making an equity contribution of W 6 billion during the 1981-1984 implementation period of the first project. Counting the W 2 billion planned for 1984, the Government's contribution during the period would amount to W 5 billion, or W 1 billion short of the original commitment. This shortfall, however, was more than compensated for by the private sector investment of W 11.7 billion during the 1981-1983 period, compared with the KTDC's original estimate of W 9 billion during 1981-1984.

4.09 For the term of the first project, the Government agreed to provide KTDC with Government loan funds and Government-guaranteed KTDC bonds totaling W 14 billion during 1982-1984. To meet the larger than anticipated demand for KTDC's local currency financing, KTDC has relied heavily on Government-guaranteed KTDC debentures (about W 25 billion). These debentures have a maturity of 4-5 years and have been floated at the market interest rate, with Government interest rate support to allow KTDC interest rate spreads of between 1.5% and 2.0% p.a. In addition, the Government has provided loans amounting to W 4 billion, at an interest rate of 8.5% p.a. and maturity of 10-15 years including 5 years of grace.

C. KTDC's Loan and Investment Portfolio and Financial Results

4.10 Although it is too early to conduct a thorough analysis of KTDC's loan and investment portfolio due to its short existence, KTDC's portfolio is generally considered sound. Out of the more than 300 subprojects financed to date, only five subprojects with an aggregate KTDC exposure of about W 0.5 billion have been classified as problem loans/investments. Most of KTDC's financial exposure in these subprojects have been recovered. Given the high risks and long gestation periods of R&D financing, KTDC was expected to incur operational losses during its initial several years of operation. Actual corporate losses incurred, which were in line with appraisal estimates, were about W 3 million, W 400 million, and W 1 billion respectively for 1981, 1982 and 1983. KTDC's capital structure and financial ratios during 1981-1983 are in line with covenants in the loan and guarantee agreements for the first project. Disbursements for the Bank loan as of end-1983 was at 83% of the appraisal estimate.

V. PROJECT OBJECTIVES AND THE BANK LOAN

A. Project Objectives and Scope

5.01 The basic goal of the proposed Project is to continue support of the Government's effort to facilitate the structural transformation of Korean industry through acceleration of industrial technology development. Specifically, the project will: (a) assist KTDC's institutional development through technical assistance, staff development, and training; (b) assist KTDC's catalytic role in technology innovation; (c) establish the foundation for a long-term resource base for KTDC; (d) expand KTDC's operations involving risk-sharing financial instruments; and (e) expand KTDC's support to SMIs.

5.02 The proposed Project consists of:

Part A: A line of credit to help cover costs of industry-sponsored R&D subprojects in 1984-86.

Part B: Institutional development of KTDC, comprising (i) consulting services to support the operations of KTDC and training of KTDC staff, both to further deepen their capacity to identify, appraise, and supervise R&D projects and to enable KTDC to carry out surveys of the technological needs of Korean industries; and (ii) purchase of training materials for KTDC staff.

B. Features of the Loan

5.03 Loan Amount: The proposed Bank loan of US$50 million, would be made directly to KTDC, and guaranteed by the Government. US$300,000 equivalent would be used for Part B; the remainder, net of the capitalized

front-end fee, would finance Part A of the Project. The proposed loan which would be fully committed by the end of 1986, would meet KTDC's anticipated foreign exchange needs during 1984-1986. The estimated costs of Part B include 15 manmonths of consulting services.

5.04 Lending Terms: The proposed Bank loan would be lent to KTDC at the Bank standard variable interest rate, with the capitalized front-end fee of 0.25% and commitment fee of 0.75% on the unused portion of the loan. Bank loans to financial intermediaries normally have flexible amortization schedules which correspond to the expected aggregate amortization schedule of the subloans to be financed. KTDC, however, represents a special case. Aside from granting conventional loans, KTDC will gradually expand its conditional loan operations (para 4.06). On such loans, not only will there be no fixed repayment at all, as royalties would basically only be due from those subprojects which are successful. Further, those subprojects for which conditional loans are requested will necessarily be those for which the greatest risk is perceived by the sponsor. As a result, the expected returns from KTDC's conditional lending operations may not in fact materialize in the first 4 to 6 years. For this reason, and at the request of the Government and KTDC, the Bank loan would be made for 11 years including 5 years of grace.

5.05 Subloan Size, Diversification of Subborrowers and Free Limit: To ensure broad impact of the loan proceeds, and in support of KTDC's efforts to diversify its operations particularly with respect to KTDC's SMI objectives (para 3.02), subloans will continue to have a ceiling of US$1.5 million equivalent. Furthermore, KTDC's outstanding financial commitments which are to be made out of the proceeds of the proposed loan to a single enterprise will not exceed US$5 million. Given the experience gained by KTDC and the demonstrated excellent performance during the first project, the free limit is proposed to be increased to US$500,000 equivalent. Subloans under the proposed free limit would be reviewed by the Bank after approval. This procedure would require the Bank's prior review for about 25-35% of the subloans.

5.06 Foreign Exchange Risk: The foreign exchange risk on the Bank loan will be passed on to the subborrowers of loans. Foreign exchange risks for the loan proceeds applicable to equity investments as well as Part B of the project would be borne by KTDC.

5.07 Retroactive Financing: The first Bank loan was fully committed at the end of August 1984. Given the current timing for Board presentation, KTDC may need to commit up to US$5 million to subprojects during the interim period. Retroactive financing of up to US$2 million from the proceeds of the proposed loan would be made to KTDC so that its operations would be minimally affected during the transition period.

C. Financial Aspects and Projections

5.08 In order to establish the foundation for a long-term resource base, KTDC plans to (a) maintain a sound capital structure; (b) establish a sufficiently large and well-diversified portfolio; and (c) maintain adequate interest rate spreads. In combination with the further improvements in KTDC's operational effectiveness and efficiency to be achieved through the institution building efforts measures as detailed below (paras 5.09-5.13) would eventually enable KTDC to mobilize an increasing portion of its own resource needs from commercial sources according to the schedule originally envisaged at the time of its establishment.

5.09 Demand for R&D financing: Given the relatively short history of R&D financing in Korea, it is not possible to accurately estimate the demand for KTDC's R&D financing during the term of the project. However, KTDC's experience during the past few years clearly indicates that there is a large unmet demand for such financing. It is also expected that KTDC's promotional activities would further increase such demand. The planned level of operations by KTDC represents about 15% of expected R&D investment by industry during 1984-86, which appears adequate. Compared with the last few years, KTDC's subprojects in the future would increasingly focus on new technologies and products as opposed to the improvements of existing technologies and products, which accounted for almost 90% of the financial assistance during 1981-83. The purchase of imported R&D equipment for private firms' newly established research centers, which showed a sharp increase in 1983, would decrease substantially during 1984-86. Therefore, the annual foreign currency lending during the term of the project is conservatively estimated to be lower than the 1983 level.

5.10 Capital Structure and Long-term Funding: To meet an expected substantial increase in the demand for R&D financing, KTDC plans to increase the level of its total capitalization (long-term debt and equity) to about W 197 billion by the end of 1986. Based on this figure, KTDC expects to have a capital structure for the project period as shown below:

Table 5.1: KTDC- Projected Capital Structure

Paid in Equity	1983 (Actual)	1984	1986	1986
		(Won Billion)		(%)
Government	3.0	5.0	12.0	6.1%
Private	11.7	13.7	25.0	12.7%
Subtotal	14.7	18.7	37.0	18.8%
Long-Term Debt				
Government Loan	4.0	6.0	41.8	21.2%
KTDC Debenture	23.9	42.9	52.4	26.6%
IBRD	12.3	28.7	65.8	33.3%
Subtotal	40.2	77.6	160.0	81.2%
Total Capitalization	54.9	96.3	197.0	100.0%

The planned level of operations requires that KTDC more than triple its total capitalization by 1986 and, consequently, its total loan and investment portfolio. This is both feasible and desirable in light of the strong emphasis being given to R&D by the Government and the private sector and of the demonstrated strong demand during the first project. In addition, a rapid expansion of operations is also required to enable KTDC to develop a sufficiently large and well-diversified portfolio and to establish itself as a commercially viable entity in the near future. The proposed equity contribution schedule is predicated on the estimates of the level of equity that could be realistically raised from the private sector and the desirability of limiting the Government's share of equity to about 30%. This level of Government's equity is sufficiently large to demonstrate official support to KTDC, and hence, to ensure the continued private sector subscription to KTDC's equity while being small enough to maintain KTDC's autonomy and operational efficiency.

5.11 The W 2 billion of equity to be contributed by the Government in 1984 is already included in the Government's 1984 budget. The Government agreed to (a) increase KTDC's authorized capital to at least W 37 billion by end 1984; (b) provide KTDC with further subscription to the paid-in capital of W 3 billion for 1985; (c) provide KTDC with Government loans of up to W 20 billion during 1984-1985 with terms and conditions acceptable to the Bank; and (d) provide the guarantee to KTDC debentures amounting to W 30 billion during 1984-1985. KTDC has also agreed to raise W 13.3 billion as further subscription to the paid-in capital by private shareholders during 1984-1986 and agreed to furnish to the Bank for its review a detailed plan for this purpose by December 31, 1984. In addition, the Government and KTDC have confirmed that necessary revisions to allow the proposed capital increase in the KTDC Act, the Enforcement Decree and the

Article of Incorporation would be made by December 31, 1984, and that on or before December 31, 1986, it would provide an additional subscription to the paid-in capital of not less than W 4 billion and an additional Government loan of up to W 18 billion, both on terms and conditions and in accordance with a timetable satisfactory to the Bank.

5.12 On the basis of the above capital structure, the implied debt/equity ratio during the project period would be about 5:1 compared with 4:1, agreed on for the first project (debt equity ratio of 10:1 is normal for DFCs in Korea). This level of debt/equity would provide a sufficiently strong capital structure for KTDC, particularly in view of the experience KTDC has gained during the first project, the larger portfolio to be developed during the term of the proposed Project and a level of equity investments and conditional loans lower than originally anticipated (paras 4.05 and 4.06). KTDC has agreed that its debt/equity ratio would not exceed 5:1 during the project implementation period.

5.13 Interest Rate Spread: Under the first project, the Government and the Bank agreed that KTDC should have a minimum spread of 2.25% for individual loans and KTDC undertook to achieve an overall average spread of 2.5%, both of which are slightly higher than those accorded to Bank-supported DFCs in Korea for subloans financed out of the proceeds of Bank loans. Higher spreads than those for DFCs are justified and necessary for KTDC, not only because its operations are risky, but also because other financial institutions have access to more profitable sources of interest income not available to KTDC, such as interest on reserves maintained at the Bank of Korea. Besides, R&D operations are usually smaller in size and require intensive staff inputs. KTDC's majority shareholders are private sector firms, who, naturally, would expect KTDC to become financially profitable and to yield a fair return on their investments in due course. It has been agreed that KTDC would charge interest on local currency as well as foreign exchange subloans made as conventional loans, which when taken together with other changes and fees levied by KTDC on such subloans, would provide KTDC with a differential of at least 2.5% above the respective cost of funds to KTDC.

5.14 Financial Projections: KTDC's financial projections have been prepared based on the assumptions detailed in Annex 9. Three major assumptions made are:

(a) the effective interest spread would be 2.5% for all conventional loans financed from all sources (para 5.13);

(b) the failure rate of conditional loans and equity investments would be 30%; and

(c) the successful equity investments could be sold at 3 times the original investment at the end of the fifth year of operations.

As experienced in other countries which are at an early stage of technological development, Korean industrialists have been focusing the majority of their R&D investments on relatively low-risk quick-return projects which are abundant in the country. As the technological capability increases and such low risk R&D investments are gradually exhausted, Korean industry would gradually shift its focus to the higher end of the technological sprectrum, which would naturally result in high-risk and high-return projects. Given the Bank's experience in countries at a similar stage of technological development, these assumptions appear to be reasonable.

5.15 KTDC's projected financial position is summarized below, while details are shown in Annex 10, and sensitivity analysis in Annex 11.

Table 5.2: KTDC - Projected Financial Position

	1984	1986	1990
	(Won Billion)		
Gross income	(0.7)	2.3	5.9
Net income	(0.7)	1.7	3.6
Portfolio:			
Conventional loans	73.2	135.8	182.4
Conditional loans	3.0	4.2	10.4
Investments	2.6	12.7	47.1
Subtotal	78.8	152.7	239.9
Long-term debt	77.6	160.0	203.7
Equity	16.8	37.1	63.2
Gross return on total assets (%)	N.A.	0.8	2.1
Debt equity ratio (times)	4.6	4.3	3.2

KTDC is expected to generate a net income of W 0.6 billion in 1985, and to wipe out its accumulated losses by 1986. Returns on total assets during the late 1980s are expected to be in the range of 0.8%-1.3%. The projected financial performance is typical of an organization such as KTDC because of the inherently high risk and long gestation period of R&D projects and the long time needed to develop a large and well-diversified portfolio of conditional loans and equity investments. To finance its operations beyond the proposed project, KTDC would require additional equity of W 16 billion and local long-term debt of W 53.0 billion as well as foreign exchange loans of about US$106 million during 1987-90. Towards the end of the 1980s, KTDC is expected to be ready to raise an increasing proportion of its long-term resources on a commercial basis.

5.16 Of the three major assumptions listed in para 5.14, KTDC's profitability is most sensitive to the effective interest rate spread

throughout the 1984-1990 period, reflecting the relatively high proportion of conventional loans in KTDC's loan and investment portfolio. In parallel with the gradual increase in the proportions of risk-sharing operations in KTDC's portfolio (para 4.06), KTDC's profitability would become increasingly more sensitive to the failure rate and the capital gains to be realized from these operations (Annex 11). Two main conclusions are derived from these projections and sensitivity analysis:

(a) Ensuring an adequate interest rate spread for conventional loans is critical for KTDC's financial viability; and

(b) Improving KTDC's operational effectiveness and efficiency involved in conditional loans and equity investments would be vital for KTDC to establish a stable long-term resource base.

D. Procurement and Disbursement

5.17 Since most of KTDC's subloans are relatively small (US$300,000 equivalent, on average) and finance many hardware and software items available only from a limited number of suppliers, procurement under the first project was made through international or local shopping in accordance with procedures acceptable to the Bank. This method of procurement, which has worked to the Bank's satisfaction under the first project, would be continued under the proposed Project. Consulting services will be engaged in accordance with Bank Guidelines for the Use of Consultants (August 1981).

5.18 The proposed Bank loan will be disbursed against: (a) 100% of foreign exchange expenditures for directly imported equipment and materials, (b) 100% of total expenditures for services and training, and (c) 60% of local expenditures for goods purchased off-the-shelf in Korea or for locally manufactured equipment and materials. All contracts for procurement of goods below US$100,000 equivalent will be disbursed against statements of expenditures (SOEs). In addition, all contracts for procurement of services below US$50,000 equivalent and for training expenses below US$50,000 will be disbursed against SOEs. Related documents will be retained by KTDC and made available for inspection by Bank supervision missions. Contracts for amounts above US$100,000 equivalent will require full documentation. Retroactive financing of up to US$2 million is expected (para 5.07). The Government and KTDC have agreed to the proposed procurement and disbursement procedures. KTDC also agreed to establish a Special Account (US$4 million equivalent) to facilitate the disbursement process. As shown in Annex 12, the Bank loan is expected to be fully committed by end-1986 and fully disbursed by December 1988.[4]/ Thus the loan closing date is proposed to be June 30, 1989.

4/ Slightly longer than the average disbursement profile for DFCs in Korea due to the nature and uncertainties of KTDC-financed projects.

E. Accounts and Audit

5.19 KTDC prepares its accounts on a commercial basis and maintains them in accordance with generally accepted accounting principles and practices. KTDC's accounts would be audited by an external auditor and audited financial statements (including documents of SOEs) would be submitted to the Bank within four months after the close of each fiscal year. These arrangements are satisfactory.

F. Project Justification and Risks

5.20 Within a short period since its establishment, KTDC has demonstrated the need and effectiveness of R&D financing activities in Korea. In line with the Government's objective, KTDC has rigorously promoted R&D projects among private sector firms and provided financial, technical, marketing, and management support. Furthermore, based on its operational experience and periodic studies conducted by its staff, KTDC is expected to continue to identify constraints and barriers in the existing policy environment designed to promote innovation by industry and to consultant frequently with relevant government agencies on measures to address these problems. The Bank's continued involvement in the institution building of KTDC through the proposed project will help KTDC to continue to fulfill and reinforce its catalytic function in further expanding industry's R&D activities, promoting closer coordination between nonprofit research institutes and private industry, accelerating technology development among SMIs, and broadening the use of risk-sharing financial instruments.

5.21 Unlike most of its counterparts elsewhere in the world, which are fully owned by their respective governments and supported by government budgets, KTDC is majority-owned by the private sector. The benefits of such an organizational and ownership structure have been obvious under the first project. Entrepreneurship and dynamism have been maintained under an independent Board and management. It continues to be of utmost importance that KTDC maintain full operational and managerial autonomy in the future. Equally important is the continued strong support of the Government, both institutional and financial, to demonstrate Government's commitment to KTDC's private shareholders and to maintain KTDC's financial viability during the early years of operations until the institution can establish a sufficiently large and well-diversified portfolio and becomes financially independent and capable of mobilizing an increasing proportion of the necessary resources from commercial sources.

5.22 As KTDC enters the second phase of its institutional development, its management and staff will have difficult tasks to perform. The greatest of all will be maintaining the delicate balance between the important intermediate- and long-term goals, such as the development of technology-intensive SMIs and expansion of risk-sharing financing operations on the one hand, and more immediate needs, such as the establishment of a profitable and viable institution. It is imperative that KTDC achieve both of

these objectives if it is to continue to play a pioneering and leadership role in R&D financing in Korea with the full support of the Government, while simultaneously continuing to enjoy the confidence and broad support of the private sector. Major risks for the project would rest in any deterioration of the support and confidence currently entrusted to KTDC and in KTDC's failure to maintain this delicate balance between medium-term and more short-term goals.

5.23 In view of these risks, several provisions are included in the project. First, KTDC would maintain a strong capital structure, which would provide an adequate financial buffer if KTDC encounters major problem loans. Second, the agreed interest rate differential on conventional loans would provide KTDC a reliable source of income to support its early years of operations when it aggressively promotes risk-sharing financing operations and R&D activities among SMIs. Third, to avoid undue risks, KTDC's conditional loans normally require a minimum repayment of loan principal (usually 30%), and in some cases, collateral is required from subborrowers with high credit risks. In addition, the Government has agreed to cover losses incurred from KTDC's conditional loans. Furthermore, as an exceptional arrangement, Korean tax law permits KTDC to set aside loss provisions of 2% on the conditional loan portfolio, compared with 1% allowed for loans for all financial institutions in Korea. In order to further develop expertise on risk-sharing operations, KTDC will continue to implement active staff development and training programs. For this purpose and, in addition to the provisions in the proposed loan, UNDP assistance has already been extended.

VI. AGREEMENTS AND RECOMMENDATIONS

6.01 The following major agreements and confirmations have been obtained:

(a) The Government will hold periodic exchanges with the Bank on its industrial technology development policies (para 2.28)

(b) KTDC will retain its ceiling of 7% on its total financial commitment at any time to any single enterprise (para 3.04);

(c) KTDC shall review with the Bank by the end of each fiscal year beginning 1984 (i) the operational targets with respect to conditional loans, conventional loans and equity investments to be approved during the following year and (ii) the operational targets for further promoting its support to small and medium industries during the following fiscal year; and on the basis of such

reviews, introduce such modifications to these targets as shall be mutually acceptable to KTDC and the Bank (paras 4.04 and 4.06);

(d) The Government will provide additional funds to cover losses suffered by KTDC on account of conditional loans made out of the proceeds of the proposed loan (para 4.06);

(e) KTDC will adopt the features of the proposed loan with regards to lending terms (para 5.04), subloan size, the diversification of subborrowers and free limit (para 5.05), and retroactive financing (para 5.07);

(f) The Government will (i) increase KTDC's authorized capital to at least W 37 billion by end 1984; (ii) provide KTDC with additional subscription to the paid-in capital of W 3 billion on or before December 31, 1985; (iii) provide KTDC with the Government loans of up to W 20 billion on or before December 31, 1985, on terms and conditions acceptable to the Bank; and (iv) provide the guarantee to KTDC debentures amounting to W 30 billion on or before December 31, 1985, on terms and conditions acceptable to the Bank (paras 5.10 and 5.11);

(g) KTDC will raise W 13.3 billion in subscription to the paid-in capital from private sector during 1984-86 (para 5.11);

(h) The Government and KTDC will adhere to a schedule for making revisions to allow the proposed capital increase in the KTDC Act, Enforcement Decree, and the Articles of Incorporation as necessary (para 5.11);

(i) KTDC will obtain the Bank's consent prior to contracting any long-term debt(s), if such debt(s) would cause KTDC's debt/equity ratio to exceed 5:1 (para 5.12);

(j) KTDC's effective minimum spreads on all conventional loans, when taking into account other charges and fees levied by KTDC, will be no less than 2.5% (para 5.13); and

(k) The Government and KTDC will follow the proposed procurement and disbursement procedures and will establish a special account of US$4 million equivalent (para 5.18).

6.02 Based on the above agreements, the proposed project is suitable for a Bank loan of US$50 million equivalent to be made to KTDC and guaranteed by the Government. Retroactive financing of up to US$2 million for the financing of KTDC's subprojects is also recommended.

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Selected Statistics on Research and Development in Korea

This Annex contains selected statistics referred to in Chapter II of the main text. Sources of these statistics include UNESCO, Ministry of Science and Technology (Korea), National Science Foundation (United States) and the Agency for Science and Technology (Japan).

I. Korea - R&D Spending by Sector
(Won billion, current prices)

	Government Institutes		Non profit Institutes		Industry		University		Total	
Korea	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
1976	20.4	34	23.3	38	15.1	25	1.9	3	60.9	100
1980	47.7	23	56.8	27	81.4	38	25.9	12	211.7	100
1981	42.3	15	103.0	35	120.7	41	27.2	9	293.1	100
1982	55.0	12	131.0	29	205.0	45	66.6	15	457.7	100

II. R&D Spending by Sector-International Comparison (%)

Country	Year	Government Institute	Non profit Institute	Industry	University	Total
Korea	1982	12	29	45	15	100
USA	1982	13	6	72	9	100
France	1979	24	1	60	16	100
Japan	1980	13	3	67	17	100

III. Proportion of Overall R&D Spending by Nature of Activity(%)

	Basic Research	Applied Research	Development	Total
Korea				
1974	26	44	30	100
1979	23	30	47	100
1981	24	29	47	100
USA				
1980	12	21	67	100
Japan				
1981	14	26	60	100
West Germany,F.R	Basic & Applied			
1977	22		78	100

IV. Korea - R&D Spending Per Researcher by Sector
(Won million, current prices)

	Public Sector		University	Industry	All Sectors
	Research Institute				
	Government	Non profit			
1976	8.2	21.2	0.4	4.6	5.2
1980	21.7	23.6	3.0	15.8	11.5
1981	19.6	35.4	3.2	16.8	14.1
1982	19.8	39.1	5.4	20.6	16.1

V. Ratio of Industry's R&D Expenditures to Total Sales Revenue(%)

	Korea				USA	Japan
	1979	1980	1981	1982	1980	1980
All Manufacturing:	0.33	0.50	0.67	0.65	2.1	1.48
Foodstuff	0.25	0.36	0.30	0.33	N.A.	N.A.
Textile	0.33	0.53	0.72	0.23	N.A.	N.A.
Chemicals	0.13	0.26	0.52	0.58	3.2	2.55
Metal Products	N.A.	0.54	0.80	0.95	1.2	N.A.
General Machinery	0.84	1.23	0.97	1.21	N.A.	1.90
Electric Machinery/ Electronics	1.52	1.90	1.73	2.44	3.9	3.71
Transportation Machinery	0.55	0.62	0.51	0.73	N.A.	2.34

VI. R&D Personnel per 10,000 Employees

	Korea (1982)	USA(1980)	Japan (1980)
All Manufacturing Industry	140	290	277
Foodstuff	117	80	191
Textile	46	30	125
Chemicals	159	410	588
Metal Products	141	140	227
General Machinery	188	370	299
Electronic Machinery/Electronics	251	440	609
Transportation Machinery	141	280	275

ANNEX 2

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Korea - Selected Incentive Schemes for R&D Activities

1. Current expenditures for R&D including personnel costs are deductable for income tax purposes. Physical and human capital expenditures necessary for upgrading industry's own technological capabilities, including industry's research institutes, research equipment, and manpower development and training, are allowed tax credit of 8-10%. An accelerated depreciation (50-90% depreciation in the first year) for R&D related capital investment is also allowed. Furthermore, imported R&D equipment enjoys substantial reduced import duties.

2. To encourage the commercialization of RD&E results, a 6% tax credit or a special accelerated depreciation (50% in the first year) for investments for the commercialization of new and/or improved technology. To encourage demand, reduced excise tax rates (30-90% reduction) are applicable to new products that have significant importance for technology development and export promotion during an introductory period of up to four years.

3. The Government also encourages transfer of technology through tax incentives. Transfer costs of patent rights and technology import fees are deductible for income tax purposes. Similarly, the income generated from technology consulting activities are exempted from income tax. Foreign engineers are also exempted from income tax.

ANNEX 3

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Types of R&D Projects Financed by KTDC

KTDC promotes and finances the following types of projects:

1. Loans for in-house R&D costs and/or for the cost of contracts for technological development with external research organizations;

2. Investments and loans for initial efforts for the commercialization of the results of research & development and/or investigation and arrangements related thereto;

3. Loans for technology import/or loans for adoption and improvement of imported technology;

4. Loans for engineering costs associated with construction of industrial facilities;

5. Technical advisory services to the industrial enterprises with respect to the business activities pursuant to the provision from item (1) through (4) and/or technical feasibility surveys for other R&D facilities; and Loans for invitation; and

6. Utilization of foreign specialists and technical advisers, and for training of R&D personnel domestically and abroad.

ANNEX 4

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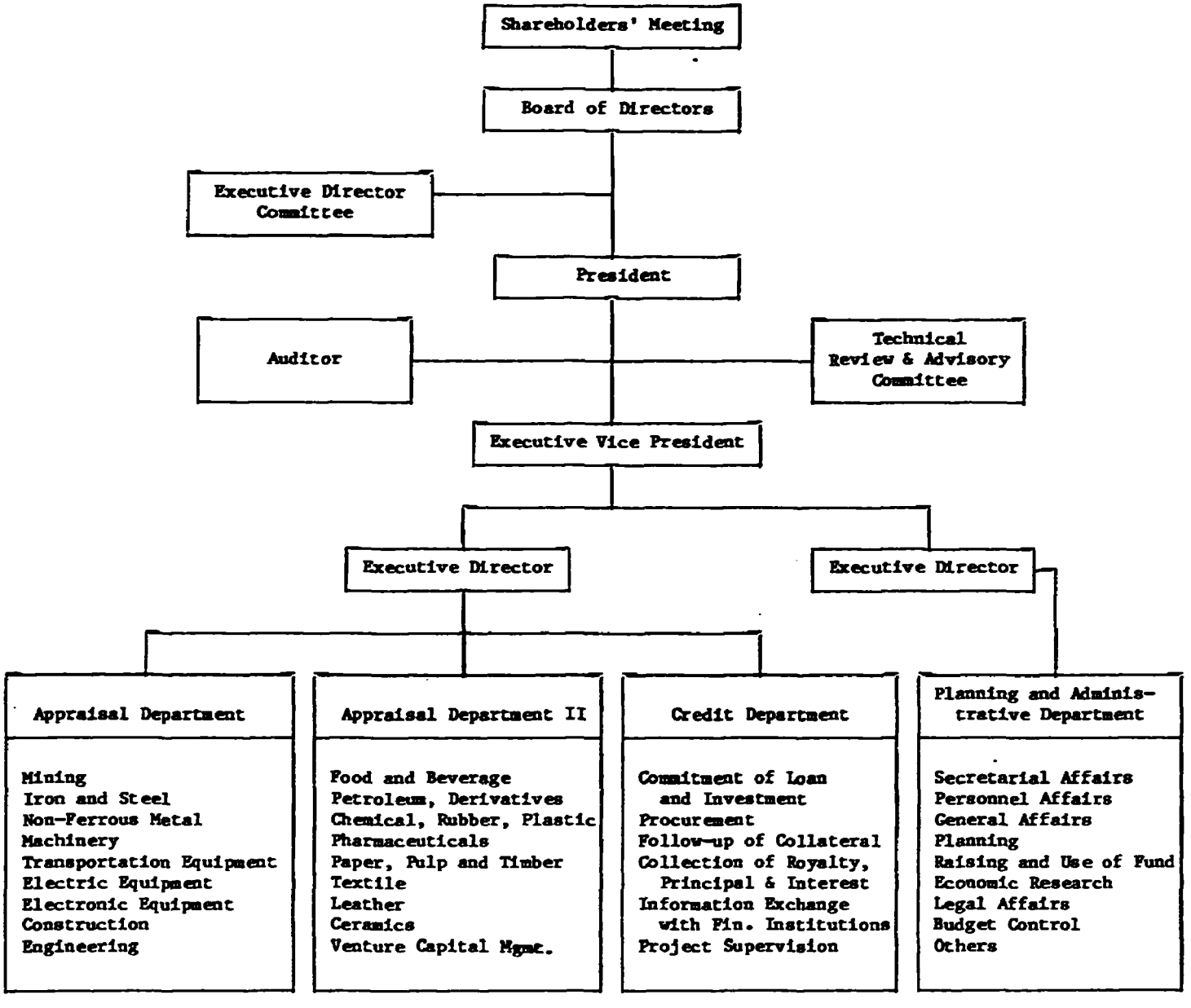
Organization Chart



ANNEX 5

KOREA

KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

KTDC - Financial Support by Subsector
(No. of Projects)

Machinery/Metal	1981[a]/	1982	1983	Total
Industrial Machinery	1	10	12	27
General Machinery	-	8	8	16
Machinery Parts	5	10	28	39
Metal	4	2	6	11
Subtotal	14	30	54	98
Subtotal (Won Billion)	1.8	6.9	17.4	26.1
Electronics/Electric				
Semiconductor	3	4	3	10
Computer	1	11	11	21
Telecommunications Equipt.	4	2	10	12
Electric Components	2	2	9	11
Electric Machinery	4	3	12	15
Subtotal	14	22	45	81
Subtotal (Won Billion)	1.6	7.6	16.8	26.0
Chemicals/Miscellaneous				
Fine Chemical	7	8	10	24
Petrochemical	4	7	10	21
General Chemical	6	4	5	15
Textile and Others	4	9	42	29
Subtotal	21	28	42	91
Subtotal (Won Billion)	2.7	7.6	15.7	26.0

a/ Eight months' of operation.

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Selected Examples of KTDC-supported Projects

A. Development of Programable Controller

KTDC invested W 80 million in a new company for a programable controller (P/C) development project. The company was founded by three technological and managerial specialists. The proposed P/C is composed of an 8 bit microprocessor (Z-80) and 32KB ROM, 2KB RAM, and 4 pieces of 48 ports I/O boards at maximum. It is designed for the control of small-scale machinery such as injection machines and elevators. The advent of a universal P/C will help many domestic small- and medium-scale machinery manufacturers who cannot establish and maintain their own digital control development facilities and thereby advance factory automation, improve production quality and productivity.

B. Development of Electro-Fax Master Paper and Fax Paper

KTDC financed an entrepreneur, who had developed office paper supplies (electro-fax master paper and facsimile paper), to commercialize his innovations. Technology related to the manufacture of the products is sophisticated since it involves a series of technical processing skills, especially in raw materials selection, blending, coating and finishing and has only recently been introduced in developing countries.

Paralleling the growth of office automation, the demand for such products has been increasing at an annual rate of more than 25%. The domestic demand in 1983 was some US$3 million. The technology acquired would also contribute to the development of related paper goods such as NCR paper, condenser paper and color master paper. In addition to a conditional loan of W 120 million, 50% of the total project cost, KTDC provided the company with various managerial services relating to accounting, management and marketing.

C. Development and Commercialization of Automatic Voltage Regulator

The product is a kind of slide-type automatic AC voltage regulator which has been developed through the new concept of an on-load tap changer. The use of two metal brushes and a low-cost EI transformer instead of carbon brushes and expensive ring-type transformer which were used exclusively in traditional slide-type AVRs, makes the product highly price competitive and reliable. KTDC arranged the business by mediating activities between the inventor and entrepreneur and extended W 200 million of risk-sharing financing. There is a large export potential for this product particularly to developing countries.

D. Development of Drive Pin

The products are advanced nails which in contrast to conventional ones, can secure hard materials such as concrete-to-concrete and steel-to-steel by using a hand held compressed air tool or blank fire gun. The loan exposure amounted to W 80 million, which comprises 88% of the total project cost of W 90 million. Domestic demand has been substantially increased from W 1 billion in 1979 to W 5 billion in 1982, reflecting the active construction sector. But to date the demand has completely been met through imports. With the development of the products, foreign exchange savings are expected to amount to W 6 billion annually and exports will be much higher.

E. Commercialization of Miniature Planes

The project sponsor plans to develop various kinds of low-cost gliders and miniature planes and supply them to the students of Korea and furthermore, to expand overseas markets with continuous R&D activities. In addition to the financial support, KTDC has arranged for a capable capitalist to joint his project with the original inventor of the proposed technology. The project will contribute to the enhancement of the scientific orientation of the pupils by enabling them to assemble and fly the proposed products by themselves.

F. Fuel Injection Pump Components for Diesel Engines

The project was to locally produce the nozzle, holder and timer parts for diesel engines which had been entirely imported. In addition, under the proposed project, the sponsor planned to develop a new injection housing model for agricultural machinery and marine engines in order to meet export demand. The project sponsor already carried out the project successfully and has been supplying the injection pump to diesel engine makers. The project sponsor was decorated with the "Industrial Copper Tower" by the Government in recognition of his pioneering efforts.

G. Development of CAB Resin Products

The project is to develop a plastic substitute for metallic materials (stainless steel or aluminum) used for decorative and protective purposes such as linings for automobiles and electric home appliances. Aluminum foil is coextruded with newly developed vegetal CAB (Cellulose Acetate Butyrate) resin characterized by its superior properties in physical strength, transparency, polished appearance and weather-resistance. The proposed project will strengthen Korea's competitiveness in the export market through cost reduction and quality improvement achieved by weight and fuel savings in automobiles and by excellent decoration in electric home appliances, etc. Also, it will contribute to the improvement in the coextrusion technology of metal with plastics.

ANNEX 7

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KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

KTDC - Financial Support by Size of Company

Number of Project:	1981	1982	1983	Total
Large companies	33	39	71	143
Small and medium	16	41	70	127
Total	49	80	141	270
Financing Amount(Won Billion)				
Local Currency Financing:				
Large companies	4.3	5.4	17.9	27.6
Small and medium	1.8	3.7	9.8	15.3
Subtotal	6.1	9.1	27.7	42.9
Foreign Currency Financing:				
Large companies	-	10.8	17.6	28.5
Small and medium	-	2.2	4.5	6.7
Subtotal	-	13.0	22.1	35.2
Total Financing:				
Large companies	4.3	16.2	35.6	56.1
Small and medium	1.8	5.9	14.3	22.1
Total	6.1	22.2	49.9	78.1

Notes: 1. Small and medium industries are defined here as enterprises with assets not more than Won 500 million (about US$630,000) or with fewer than 300 employees, except for those subsector industries where the employment ceiling was raised to 500. (The Small and Medium Industry Promotion Law).

2. There was no foreign currency operation during 1981. The First Technology Development Project (Loan 2112-KO) was approved in March 1982.

ANNEX 8

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KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

KTDC- Financial Support by Financial Instruments

Amount(Won Billion)	1981		1982		1983		Total	
	Actual	Appraisal[a/] Estimate	Actual	Appraisal[a/] Estimate	Actual	Appraisal Estimate	Actual	Appraisal Estimate
Conventional Loan:								
With Collateral	3.5	N.A.	11.5	N.A.	18.2	N.A.	33.2	N.A.
Without Collateral	2.1	N.A.	8.5	N.A.	29.7	N.A.	40.3	N.A.
Sub-total	5.6	3.3	20.0	11.4	47.9	14.4	73.5	29.1
Conditional Loan	0.5	0.2	1.8	2.1	1.0	5.2	3.3	7.6
Equity Investment	0.0	0.0	0.3	0.7	1.0	1.0	1.3	1.7
Grand Total	6.1	3.5	22.1	2.8	49.9	6.2	78.1	38.4
Proportion(%)								
Conventional Loan:								
With Collateral	57	N.A.	52	N.A.	36	N.A.	42	N.A.
Without Collateral	35	N.A.	39	N.A.	60	N.A.	52	N.A.
Sub-total	92	97	91	80	96	70	94	76
Conditional Loan	8	3	8	14	2	25	4	19
Equity Investment	0	0	1	6	2	5	2	5
Grand Total	100	100	100	100	100	100	100	100

a/ First Technology Development Project: SAR No. 3707-KO of February 25, 1982.

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KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

ASSUMPTIONS MADE ON FINANCIAL PROJECTIONS 1984-1990

The following assumptions were made in projecting KTDC's financial statements for the 1984-1990 period:

(FIGURES IN MILLION WON)

		ACTUALS			FORECAST						
A. OPERATIONAL TARGETS		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1. APPROVALS											
LOCAL CURRENCY:	TOTAL	6,092	9,147	27,730	39,800	44,000	49,000	56,000	60,000	65,000	70,000
	CONVENTIONAL	5,572	7,604	25,803	35,100	38,720	41,650	45,920	48,000	52,000	52,500
	CONDITIONAL	520	1,243	970	940	880	1,470	1,680	1,800	2,600	2,800
	EQUITY	0	300	957	3,760	4,400	5,880	8,400	10,200	10,400	14,700
FOREIGN CURRENCY:	TOTAL	0	13,016	22,138	15,200	18,000	20,000	22,000	22,000	22,000	22,000
	CONVENTIONAL	0	12,442	22,138	15,200	16,920	18,400	20,020	19,800	19,800	19,250
	CONDITIONAL	0	574	0	0	180	400	440	440	660	660
	EQUITY	0	0	0	0	900	1,200	1,540	1,760	1,540	2,090
TOTAL APPROVALS:	TOTAL	6,092	22,163	49,868	55,000	62,000	69,000	78,000	82,000	87,000	92,000
	CONVENTIONAL	5,572	20,046	47,941	50,300	55,640	60,050	65,940	67,800	71,800	71,750
	CONDITIONAL	520	1,817	970	940	1,060	1,870	2,120	2,240	3,260	3,460
	EQUITY	0	300	957	3,760	5,300	7,080	9,940	11,960	11,940	16,790
2. DISBURSEMENTS											
LOCAL CURRENCY:	TOTAL	1,149	5,774	16,908	33,762	41,894	46,559	52,521	58,012	62,580	67,520
	CONVENTIONAL	1,149	4,736	15,777	30,452	36,910	40,185	43,785	46,960	50,000	52,250
	CONDITIONAL	0	938	935	952	904	1,234	1,596	1,752	2,280	2,720
	EQUITY	0	100	196	2,359	4,080	5,140	7,140	9,300	10,300	12,550
FOREIGN CURRENCY:	TOTAL	0	4,122	8,163	16,439	19,049	18,038	20,088	21,396	22,110	22,110
	CONVENTIONAL	0	3,952	8,020	16,178	18,491	16,676	18,294	19,306	19,888	19,635
	CONDITIONAL	0	170	143	261	108	312	424	440	572	660
	EQUITY	0	0	0	0	450	1,050	1,370	1,650	1,650	1,815
GRAND TOTAL:	TOTAL	1,149	9,896	25,071	50,201	60,943	64,597	72,609	79,408	84,690	89,630
	CONVENTIONAL	1,149	8,688	23,797	46,630	55,401	56,861	62,079	66,266	69,888	71,885
	CONDITIONAL	0	1,108	1,078	1,213	1,012	1,546	2,020	2,192	2,852	3,380
	EQUITY	0	100	196	2,359	4,530	6,190	8,510	10,950	11,950	14,365

B. BORROWINGS FROM THE GOVERNMENT

1. Borrowing rate: 8.5% p.a.
2. Maturity:

   (a) Borrowings in 1981: 10 years including grace period of 5 years;

   (b) Borrowings after 1981: 15 years including grace period of 5 years.

C. DEBENTURES

1. KTDC debentures would be issued as follows:

---Issue--- No.	Date	Amount Million Won	Discount %	Maturity Years	Interest Rate %
1.	1983	15,500	7	5	12.5[1]/; 10.4[2]/ 10.8[3]/
2.	1983	10,000	5	4	11.0 [1]/
3.	1984	20,000	1.5	4	10.4 [2]/
4.	1985	10,000	1.5	4	10.8 [4]/
5.	1988	40,000	1.5	4	10.8
6.	1989	15,000	1.5	4	10.8

2. Interest Rate Support: The Government's interest support on KTDC debentures would be as follows:

   Issuance Rate - Lending Rate (10%)
   + (Discount/Maturity) + Margin (2.5%)

3. Issuing Costs: 1.3% of issuing amount.

1/ 1st year.
2/ 2nd and 3rd year.
3/ 4th and 5th year.
4/ 4th year.

D. EQUITY: Equity would be raised as shown. Stock costs have been assumed to be 2.5% of issuing amount.

	1984	1985	1986	1987	1988	1989	1990
Gov't	2,000	3,000	4,000	0	0	0	0
Private	2,000	6,300	5,000	5,000	5,000	3,000	3,000
Total	4,000	9,300	9,000	5,000	5,000	3,000	3,000

E. FOREIGN BORROWINGS:

Borrowing No.	Amount (Million Won)	Year	Exch. Rate 1/	Interest %	Front end Fee %	Commitment %	Maturity/ Grace
1.	39,000	1982	750	11.6	1.50	0.75	14/5 years
2.	40,000	1984	800	10.0	0.25	0.75	15/3 years
3.	35,000	1986	800	10.0	0.25	0.75	15/3 years
4.	10,000	1988	800	10.0	0.25	0.75	15/3 years
5.	30,000	1990	800	10.0	0.25	0.75	15/3 years

1/ To the US$ Dollar.

F. KTDC LENDING TERMS

1. Conventional loans:

	Local Currency	Foreign Currency
(a) Interest	10% p.a.	10% p.a. (1st loan) 12.5% p.a. (2nd project and thereafter)
(b) Commitment fees	0.5% p.a.	1.5% p.a.
(c) Maturity	4.5 years	7.0 years
(d) Grace Period	1.5 years	2.5 years

Note: Conventional loans extended without collateral, which would account for 55% the overall portfolio, would have an additional 1% surcharge.

2. Conditional loans: Conditional loans do not have a fixed repayment schedule. The return on such loans is in the form of negotiated royalty payments (about 5% of sales) from successful subprojects. It has been assumed that:

(a) 30% of the subprojects fail, while 70% suceed;

(b) for failed subprojects, KTDC will recover only 30% of the principal (recovery assumed in the fourth year);

(c) for successful projects, KTDC will recover principal and interest in the form of royalty payments as follows:

Year:	0	1	2	3	4	5	6	7	Total
Principal	(100)	4	21	24	30	21	-	-	100
Royalties	-	-	-	13	20	29	50	38	150
Total	(100)	4	21	37	50	50	50	38	250

The imputed ex ante rate of return for a successful subproject is 23% while that of the overall portfolio of conditional loans (including failures) is 15%.

3. Equity Investments: It has been assumed that:

(a) 30% of the subprojects fail, while 70% suceed;

(b) for failed subprojects, KTDC will recover no original investment; and

(c) for successful subprojects, KTDC will be able to sell out its equity investment with a capital gain of 200% in the fifth year in addition to modest dividends receipts as shown below:

Year:	0	1	2	3	4	5
Investment	(100%)					(100%)
Dividends	(100)	-	-	5	10	15
Capital Gain	-	-	-	-	-	200
Total	(100)	0	0	5	10	315

The imputed ex ante rate of return for a successful subproject is 27% while that of the overall portfolio of equity investments (including failures) is 18%.

G. DISBURSEMENT PATTERNS: The disbursement patterns shown in Table A2 above were based on the following assumptions:

1. Conventional loans:

Year:	0	1	2
Local Currency	50%	50%	-
Foreign Currency	30%	30%	40%

2. Conditional loans:

Year:	0	1
Disbursement	60%	40%

H. PROVISION FOR BAD DEBT: The rates allowed under Korean tax laws are:

1. Conventional loans: 1% of disbursed amounts
2. Conditional loans: 2% of disbursed amounts

In addition, starting 1985 for equity investments, 2% of the invested amounts is set aside as provision for failure, taking into account the KTDC management's plan to initiate a discussion with the government to revise Korea tax laws to allow such provisions.

I. DEPRECIATION RATES (on straight line methods):

1. Front-end fee: 11 years
2. Fixed assets: 10 years
3. Bond/Stock issue costs: 3 years
4. Discount on bonds: (a) 5 years for first issue
   (b) 4 years for subsequent issues

J. OTHERS

1. Earnings on liquidity (cash/cash equivalents and convertible bonds): 12% p.a.
2. Administrative expenses: assume to increase at 10% p.a.

KOREA

KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

FUNDS FLOW STATEMENT

(FIGURES IN MILLION WON)

	ACTUALS			FORECAST						
SOURCES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
NET INCOME	(28)	(400)	(1,056)	(717)	587	1,691	1,969	2,106	2,483	3,556
DEPRECIATION & AMORTIZATION	283	164	558	943	1,177	990	1,044	1,082	1,165	1,148
INTERNAL CASH GENERATION	255	(236)	(498)	226	1,764	2,681	3,013	3,188	3,648	4,704
EQUITY- GOV'T.	1,000	1,000	1,000	2,000	3,000	4,000	0	0	0	0
- PRIVATE	6,553	1,266	3,860	2,000	6,300	5,000	5,000	5,000	3,000	3,000
BORROWINGS- GOV'T.	1,000	1,500	1,500	2,000	18,000	18,000	0	0	0	0
- BONDS (less Discount)	0	0	23,915	19,000	9,500	0	0	38,000	14,250	0
- FOREIGN	0	4,122	8,163	16,439	19,049	18,038	20,088	21,396	22,110	22,110
REPAYMENT OF CONV. LOANS	0	0	562	5,809	17,144	31,800	44,913	54,985	60,341	63,164
ROYALTY FROM CONDITIONAL LOANS	0	0	122	276	526	798	952	935	1,009	1,215
DISPOSAL OF EQUITY INVESTMENT	0	0	100	0	0	0	0	196	1,651	3,171
LOSS PROVISIONS	11	109	253	427	483	389	363	357	371	418
LOSSES ON LOANS/INV. PORTFOLIO	0	0	0	0	0	362	382	1,071	1,663	2,321
PROV. FOR SEVERANCE	39	49	59	65	72	79	87	95	105	115
INCR. IN CUR LIABILITIES	36	305	603	1,268	1,548	2,144	1,885	2,441	2,782	2,779
TOTAL	8,894	8,115	39,639	49,510	77,385	83,291	76,684	127,665	110,929	102,997
APPLICATIONS										
DISBURSEMENTS -CONVENTIONAL	1,149	8,688	23,797	46,630	55,401	56,861	62,079	66,266	69,888	71,885
-CONDITIONAL	0	1,108	1,078	1,213	1,012	1,546	2,020	2,192	2,852	3,380
-EQUITY INV	0	100	196	2,359	4,530	6,190	8,510	10,950	11,950	14,365
REPAYMENTS	0	0	0	0	0	200	12,574	40,448	24,731	16,531
PAYMENT OF FRONT-END FEE	0	549	0	100	0	88	0	25	75	0
DEFERRED CHARGES - ORGANIZING	334	0	0	0	0	0	0	0	0	0
- STOCK ISSUE	0	56	120	100	233	225	125	125	75	75
- BOND ISSUE	0	0	332	260	130	0	0	520	195	0
- BOND DISCOUNT	0	0	1,585	1,000	500	0	0	2,000	750	0
NET INCR OF FIXED ASSETS	176	6	167	59	65	71	79	86	0	0
INCR. IN INTEREST RECEIVABLES	187	154	701	636	1,713	1,504	2,350	1,955	2,655	2,194
SEVERANCE PAYMENT	0	8	3	0	0	0	0	0	0	0
OTHER APPLICATIONS OF FUNDS	641	168	1,422	0	0	0	0	0	0	0
TOTAL	2,487	10,837	29,101	52,356	63,584	66,684	87,737	124,567	113,171	108,430
INCREASE(DECREASE) IN CASH	6,407	(2,722)	10,539	(2,846)	13,801	16,607	(11,054)	3,098	(2,242)	(5,433)

K O R E A

KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

INCOME STATEMENT

(FIGURES IN MILLION WON)

	A C T U A L S			F O R E C A S T						
REVENUES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
DIVIDENDS	0	0	0	0	5	20	117	353	781	1,207
ROYALTIES	0	0	5	9	144	362	647	1,129	1,489	1,440
INTEREST ON LOANS	8	412	2,627	7,902	12,587	16,031	17,803	19,242	20,462	21,416
CAPITAL GAINS FROM EQ INV.	0	0	0	0	0	0	0	392	3,302	6,342
INTEREST ON DEPOSITS/CASH	941	962	1,442	1,536	2,193	4,018	4,351	3,874	3,925	3,465
COMMITMENT FEES	5	85	240	430	427	436	471	496	506	509
INTEREST ON CONV. BONDS	0	6	24	55	116	193	275	363	457	561
MISCELLANEOUS	0	0	57	0	0	0	0	0	0	0
TOTAL	954	1,465	4,395	9,932	15,471	21,059	23,664	25,848	30,921	34,939
EXPENSES										
INTEREST	34	273	2,993	7,486	11,264	14,765	16,116	17,307	20,892	22,245
COMMITMENT FEES	0	155	240	289	306	392	474	318	267	214
DEPRECIATION & AMORTIZATION	283	164	558	943	1,177	990	1,044	1,082	1,165	1,148
PERSONNEL & ADMINISTRATION	612	1,112	1,244	1,440	1,584	1,742	1,917	2,108	2,319	2,551
PROV. FOR SEVERANCE	39	49	59	65	72	79	87	95	105	115
PROV. FOR LOSSES	11	109	253	427	483	389	363	357	371	418
LOSSES ON LOAN/INV. PORTFOLIO	0	0	0	0	0	362	382	1,071	1,663	2,321
MISCELLANEOUS	3	3	104	0	0	0	0	0	0	0
TOTAL	982	1,865	5,451	10,650	14,884	18,719	20,383	22,339	26,782	29,012
INCOME BEFORE TAXES	(28)	(400)	(1,056)	(717)	587	2,340	3,281	3,510	4,139	5,927
ALLOWED CUM NIBT	(28)	(428)	(1,484)	(2,173)	(1,186)	1,623	3,281	3,510	4,139	5,927
TAXES	0	0	0	0	0	649	1,313	1,404	1,656	2,371
NET INCOME	(28)	(400)	(1,056)	(717)	587	1,691	1,969	2,106	2,483	3,556

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KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

BALANCE SHEET

(FIGURES IN MILLION WON)

	ACTUALS			FORECAST						
ASSETS	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
CASH & CASH EQUIVALENTS	6,407	3,685	14,224	11,377	25,179	41,786	30,732	33,830	31,588	26,155
INTEREST RECEIVABLES	187	341	1,042	1,678	3,391	4,895	7,245	9,201	11,855	14,049
CONVENTIONAL LOANS	1,149	9,837	33,072	73,893	112,150	137,211	154,377	165,657	175,205	183,925
(PROVISION FOR BAD DEBTS)	(11)	(98)	(332)	(741)	(1,123)	(1,374)	(1,546)	(1,658)	(1,754)	(1,841)
CONDITIONAL LOANS	0	1,108	2,064	3,001	3,487	4,235	5,303	6,560	8,403	10,569
(PROVISION FOR BAD DEBTS)	(0)	(22)	(41)	(60)	(70)	(85)	(106)	(131)	(168)	(211)
EQUITY INVESTMENTS	0	100	196	2,555	7,085	13,275	21,785	32,539	42,838	54,032
(PROVISION FOR EQUITY LOSSES)	0	0	0	0	(91)	(214)	(385)	(604)	(843)	(1,130)
(LOSSES INCURRED)	0	0	0	0	0	(362)	(745)	(1,816)	(3,479)	(5,799)
FIXED ASSETS	176	182	349	408	473	544	623	709	709	709
(CUM DEPRECIATION)	(29)	(71)	(103)	(144)	(191)	(246)	(308)	(379)	(450)	(521)
PREPAID FRONT-END FEE	0	527	487	541	495	530	477	448	463	403
DEFERRED CHARGES	334	390	2,427	3,787	4,649	4,874	4,999	7,644	8,664	8,739
(CUM AMORTIZATION)	(254)	(354)	(840)	(1,696)	(2,779)	(3,662)	(4,592)	(5,548)	(6,583)	(7,600)
OTHER LONG-TERM ASSETS	641	809	1,931	1,931	1,931	1,931	1,931	1,931	1,931	1,931
TOTAL ASSETS	8,600	16,434	54,475	96,530	154,585	203,337	219,792	248,382	268,380	283,410
LIABILITIES AND EQUITY										
CURRENT LIABILITIES	36	341	944	2,212	3,760	5,904	7,789	10,230	13,012	15,792
GVT LT DEBT	1,000	2,500	4,000	6,000	24,000	41,800	41,450	40,950	40,250	37,750
BONDS	0	0	23,915	42,915	52,415	52,415	42,415	44,915	49,165	49,165
IBRD & OTHER LT DEBT	0	4,122	12,285	28,724	47,773	65,811	83,675	100,623	108,702	116,781
SEVERANCE LIABILITY	39	80	136	201	273	351	438	533	638	753
TOTAL LIABILITIES	1,075	7,043	41,280	80,053	128,221	166,281	175,767	197,251	211,767	220,240
GVT EQUITY	1,000	2,000	3,000	5,000	8,000	12,000	12,000	12,000	12,000	12,000
PRIVATE EQUITY	6,553	7,819	11,679	13,679	19,979	24,979	29,979	34,979	37,979	40,979
RETAINED EARNINGS	(28)	(428)	(1,484)	(2,202)	(1,615)	77	2,045	4,151	6,635	10,191
TOTAL EQUITY	7,525	9,391	13,195	16,477	26,364	37,056	44,024	51,130	56,614	63,170
TOTAL LIABILITIES & EQUITY	8,600	16,434	54,475	96,530	154,585	203,337	219,792	248,382	268,380	283,410
DEBIT/EQUITY RATIO	0.1	0.7	3.0	4.7	4.7	4.3	3.8	3.6	3.5	3.2
RETURN ON ASSETS (BEFORE TAX)	-0.3%	-2.6%	-2.7%	-2.3%	-0.8%	0.8%	1.5%	1.4%	1.5%	2.1%
RETURN ON ASSETS (AFTER TAX)	-0.3%	-2.4%	-1.9%	-0.7%	0.4%	0.8%	0.9%	0.8%	0.9%	1.3%
RETURN ON EQUITY (BEFORE TAX)	-0.4%	-4.6%	-11.2%	-13.2%	-4.5%	4.4%	7.5%	6.9%	7.3%	9.4%
RETURN ON EQUITY (AFTER TAX)	-0.4%	-4.3%	-8.0%	-4.4%	2.2%	4.6%	4.5%	4.1%	4.4%	5.6%

ANNEX 11

KOREA
SECOND TECHNOLOGY DEVELOPMENT PROJECT
SUMMARY OF SENSITIVITY ANALYSIS

Given the Agreement reached on the effective interest rate spread of 2.5% on all conventional loans, the remaining major uncertainties are (a) the failure rates for KTDC's conditional loans and equity investments and (b) the weighted average capital gains from KTDC's successful equity investments. Sensitivities of these uncertainties on KTDC's net income in 1988 and 1989 are shown below:

KTDC's Net Income in 1988
(Won Billion)

	Average Capital Gains on Equity Investments		
Failure Rate	150%	200% (Base Case)	250%
20%	2.1	2.2	2.2
30% (Base Case)	2.0	2.1	2.2
40%	1.9	2.0	2.1

KTDC's Net Income in 1989
(Won Billion)

	Average Capital Gains on Equity Investments		
Failure Rate	150%	200% (Base Case)	250%
20%	3.2	4.4	5.6
30% (Base Case)	2.5	3.6	4.6
40%	1.8	2.7	3.6

It should be noted that there are only marginal differences in KTDC's net income during the 1984-87 period. However, as the proportion of equity investments and conditional loans increase, and the increasingly large number of subprojects reveal their successes or failures (the average gestation period being 4-5 years), KTDC's net income becomes increasingly sensitive to the level of (a) and (b) above.

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KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

Disbursement Schedule

IBRD Fiscal Year	Quarter	Disbursement (US$ Million) Quarterly	Cumulative	Profile 1/
1985				
	II	4.0	4.0	-
	III	1.5	5.5	0.5
	IV	2.0	7.5	
1986	I	3.0	10.5	7.5
	II	3.5	14.0	
	III	3.5	17.5	18.5
	IV	4.0	21.5	
1987	I	4.0	25.5	30.0
	II	4.5	30.0	
	III	4.5	34.5	40.0
	IV	4.5	39.0	
1988	I	3.5	42.5	46.0
	II	3.0	45.5	
	III	1.5	47.0	49.0
	IV	1.0	48.0	
1989	I	1.0	49.0	50.0
	II	1.0	50.0	

1/ Average for the IDF sector in Korea.

ANNEX 13

KOREA

KOREA TECHNOLOGY DEVELOPMENT CORPORATION

SECOND TECHNOLOGY DEVELOPMENT PROJECT

Selected Documents and Data Available in the Project File

A. Korea - Revised Fifth Five-Year Plan
Chapter 3 "Technological Innovations and Increasing Industrial Technological Capacity'

B. KTDC - Roster of Shareholders

C. KTDC - Statement of Investment and Operational Policies

D. KTDC - Statement of Rules on the Lending and Equity Participation

E. UNDP - KTDC Institutional Development Project Documents

F. KTDC - Organizational Chart

G. Science and Technology Annual Report MOST, 1983

H. Korea Technology Development Act and Enforcement Decree

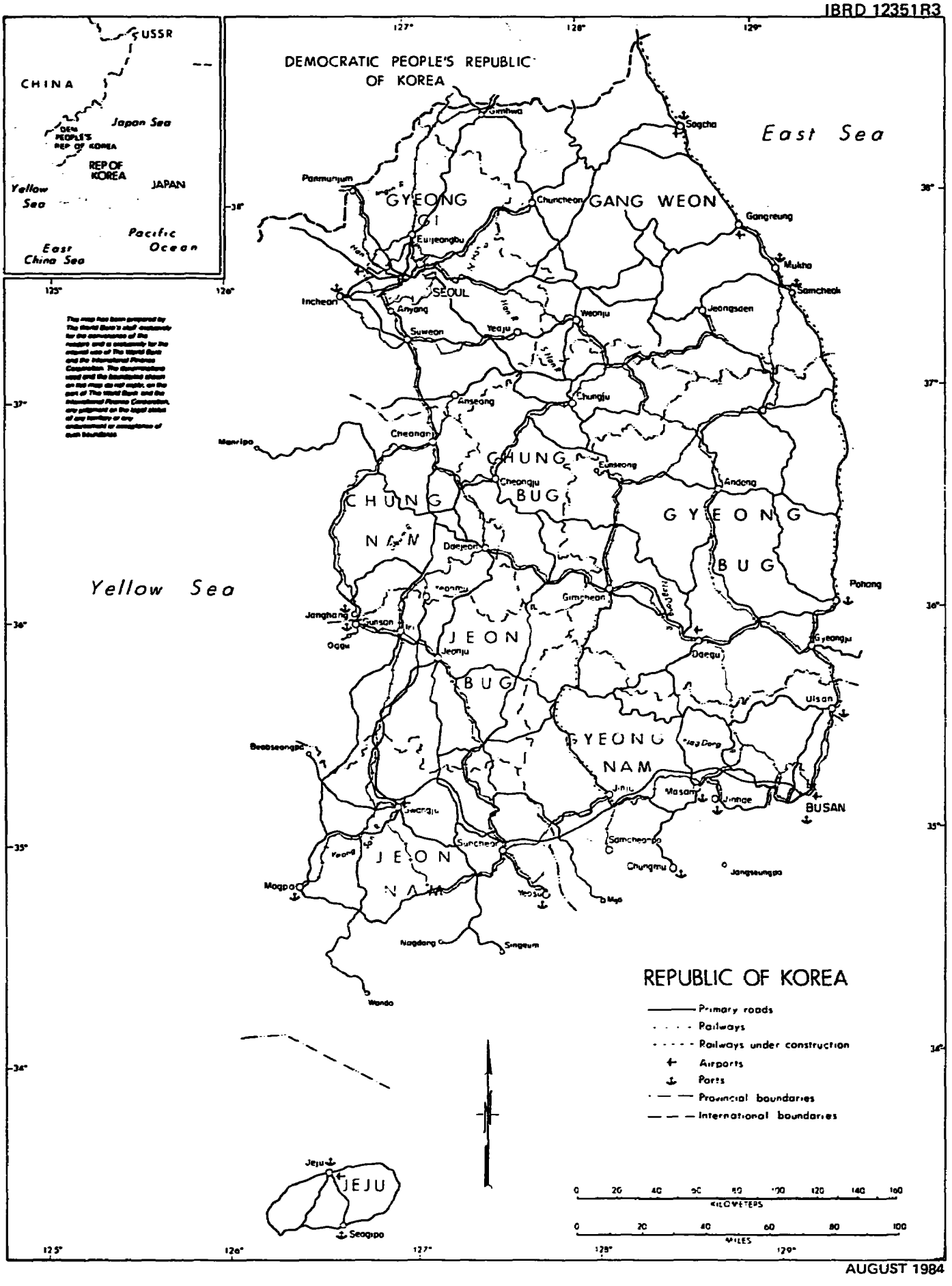
I. KTDC - Articles of Incorporation

J. "The Venture Capital Industry in the United States" KTDC Staff Working Paper, April 1984.

K. "Measures for Vitalizing Venture Capital to Develop Advanced Technology" KDB Monthly Economic Review, January 1984

L. KTDC - Corporation Agreements with KDIC, KTAC, SMIPC, KAIST and Korea Exchange Bank

IBRD 12351R3



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